Aviation Week

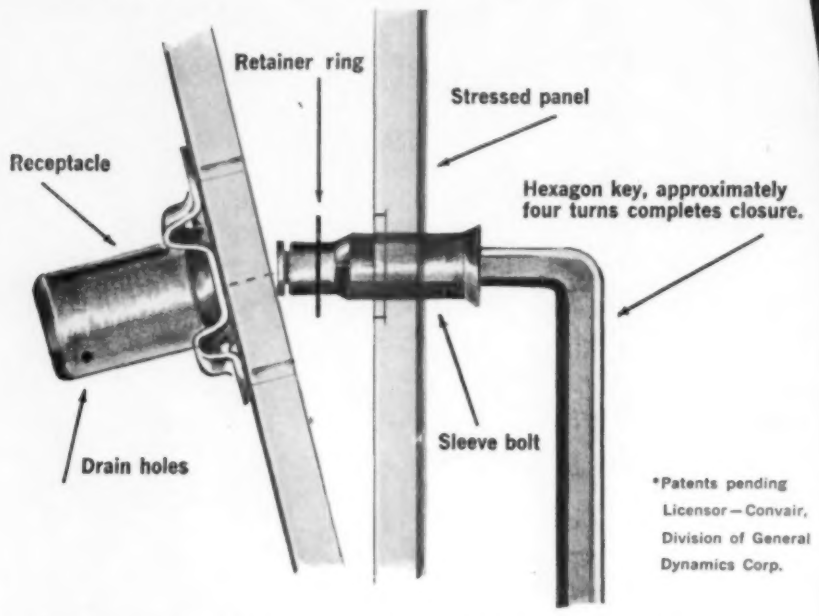
Including Space Technology

April 13, 1959

Speed Marks Jupiter IRBM Development

MILSON STRESSED PANEL FASTENER...

The First Fool-Proof, Quick-Operating Panel Fastener!



*Patents pending
Licensor—Convair, Division of General Dynamics Corp.

For the first time, the Milson Fastener allows the stressed panel assembly to become an integral part of primary structure. For frequent servicing of components, with greatly reduced time, the Milson Fastener closes gaps up to .125 in., permits installation with hole misalignments up to .040 in., contains deep hexagon socket for superior power driving and high pre-load. Designed with only four parts and nothing to adjust, it provides two lug and corner floating receptacle styles, is manufactured in two temperature ranges—alloy steel for 550°F and corrosion resistant steel for 700°F service.

The sleeve bolt has a shear groove in the head to prevent over-torquing. This fastener has a common hole size in the panel and substructure, and all parts are completely interchangeable.

This is the newest and only device available that permits quick access to black box equipment as often as required... never before possible with stressed panels.

Technical assistance for your stressed panel requirements available on request.

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a division of Pheoll Manufacturing Company
8463 Higuera Street, Culver City, California

HERE'S SKID PROTECTION

sure and simple

Basic units of the Goodyear Anti-Skid System—specified for the Convair B-58 and Republic F-105. Installed on a 2-wheel fighter, the system weighs under 6 lbs.

1 FIRST, CONSIDER THIS—At today's high landing speeds, a skidding tire can "flat spot" in two seconds. Several seconds later, it will blow out—endangering plane and personnel, requiring costly down time that can wreck flight schedules. The pilot—sitting ahead of wheels—can be unaware of danger until too late.

2 TO ANSWER THE PROBLEM—Goodyear offers *three* compact skid control systems: *Skid Warning System** instantly raps the pilot's brake-pedal foot when skid is imminent. He allows for skid, keeps control.

Anti-Skid System automatically releases brake pressure until skid danger has passed. Brake is reapplied automatically.

Pilot Modulated Anti-Skid System is combination of other two. Provides automatic skid protection yet allows pilot control if desired.

3 PROOF OF EFFECTIVENESS? *Goodyear Anti-Skid System*—specified for both the Convair B-58 and Republic F-105.

Goodyear Skid Warning System—exhaustively tested and enthusiastically received by military and commercial pilots. FAA-approved for Douglas DC-7B and DC-7C Aircraft.

Goodyear Pilot Modulated System—now proving itself on one of the newest military jets.

4 FOR DETAILED INFORMATION on these 3 miniaturized, lightweight skid control systems—and specific facts that will help you decide which system is best for you—write Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.

AVIATION PRODUCTS BY

GOODYEAR

*Patents pending

59-33

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Phileas Fogg needed eighty days to see what the Explorer scans in minutes. Ex-Cell-O Corporation was not then in business to help speed his trip—it was 1923 that Ex-Cell-O started making aircraft parts to tolerances until then deemed impossible in production.

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AVIATION CALENDAR

Apr. 21-23—Ninth Annual Convention, International Airline Navigators Council, Hotel Manhattan, New York, N. Y.

Apr. 22-24—1959 Annual Meeting, Institute of Environmental Engineers, LaSalle Hotel, Chicago, Ill.

Apr. 23—Annual Eastern Regional Meeting, Institute of Navigation, Friendship International Airport, Baltimore, Md.

Apr. 23-24—Quarterly Regional Meeting, Assn. of Local and Territorial Airlines, Bel Air Motor Hotel, St. Louis, Mo.

Apr. 27-29—13th Annual Meeting, Aero Medical Assn., Statler Hilton Hotel, Los Angeles, Calif.

Apr. 29-May 1—First National Metals Engineering Conference, American Society of Mechanical Engineers, Hotel Sheraton-Ten Eyck, Albany, N. Y.

Apr. 30-May 1—Controllable Satellites Conference, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.

Apr. 30-May 1—Second Annual Meeting Aircraft Electronics Assn., McAllister Hotel, Miami, Fla.

May 3-7—Symposium on Electrode Processes, Phila., Pa. Sponsors: AFOSR/Chemistry Division and Electromechanical Society. (Contact Electrochemical Society, Inc., 1860 Broadway, N.Y.C.)

May 4-6—National Aeronautical Electronic Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 4-7—Fifth Annual Flight Test Instrumentation Symposium, sponsored by the Instrument Society of America, Seattle Section, Olympic Hotel, Seattle, Wash.

May 5-7—Joint Meeting, International Scientific Radio Union and Institute of Radio Engineers, Willard Hotel, Washington, D. C.

May 5-7—Annual Meeting, California Assn. of Airport Executives, Casa Munros Hotel, Monterey, Calif.

(Continued on page 6)

AVIATION WEEK Including Space Technology

April 13, 1959
Vol. 70, No. 15

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Publication Office, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary. Officers of the Publications Division: Nelson L. Bond, President; Harry L. Waddell, Senior Vice President; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription order.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada $8 one year. All other countries, $20 one year.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.
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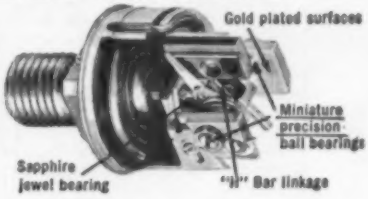
Fairchild's line of Pressure Transducers include bourdon tube and capsular diaphragm types for measuring pressures from 1 to 10,000 psi, absolute, gauge, or differential. Standard units have pot pick-offs; a.c. type pick-offs available on special order.



SPECIFICATIONS AND CHARACTERISTICS			
Vibration	10 to 55 cps, 0.1" da; 55 to 2,000 cps 15g. Error less than 1%. Will withstand 25g, 10 to 2,000 cps.	Pressure Range	0-5 psi to 0-350 psi a, g or d.
Acceleration	40g in 3 planes; error less than 1%. Withstands 75g.	Linearity	±1.0%
Shock	50g without damage or permanent calibration shift.	Size (Volume)	½ cubic inch (1" dia x 1" long)
		Temperature	—54°C to +100°C. Error less than 1% for most ranges.

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THERMA-flex high-efficiency tube shield liners are available now for most sizes and types of IERC Miniature Heat-dissipating Electron Tube Shields.

*See NEL Reliability Design Handbook, Sec. 502—"Improved Type Miniature Tube Shields," OTS—Jan. 15, 1959

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Heat-dissipating electron tube shields for miniature, subminiature and octal/power tubes.

AVIATION CALENDAR

(*Continued from page 5*)

May 6-8—1959 Electronic Components Conference, Benjamin Franklin Hotel, Philadelphia, Pa.

May 6-9—15th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 7-10—Annual Meeting, National Intercollegiate Flying Assn., University of Illinois' Airport, Champaign, Ill.

May 15-16—Spring Meeting, Society of Aircraft Materials and Process Engineers—Eastern Division, Hotel Statler, New York, N. Y.

May 18—Symposium on Space Medicine Electronics, Franklin Institute, Philadelphia, Pa.

May 18-21—18th Annual National Conference, Society of Aeronautical Weight Engineers, Hotel Henry Grady, Atlanta, Ga.

May 20-22—National Spring Meeting & Exhibition, Society for Experimental Stress Analysis, Sheraton Park Hotel, Washington, D. C.

May 20-22—Second Jet Age Airport Conference, American Society of Civil Engineers, Shamrock-Hilton Hotel, Houston, Tex.

May 21-22—1959 Ohio Valley Instrument and Automation Exhibit and Symposium, Cincinnati Section, Instrument Society of America, Music Hall, Cincinnati, Ohio.

May 24-June 5—Federation Aeronautique Internationale Annual Meeting, Moscow, USSR.

May 25-27—1959 National Telemetering Conference on Investigation of Space, Brown Palace and Cosmopolitan Hotel, Denver, Colo. Sponsors: American Rocket Society, Institute of the Aeronautical Sciences, American Institute of Electrical Engineers and Instrument Society of America.

May 25-27—All Industry Production and Quality Control Exposition and Convention, American Society for Quality Control, Cleveland Public Hall and Hotel Sheraton, Cleveland, Ohio.

May 25-28—Design Engineering Show and Conference, American Society of Mechanical Engineers, Convention Hall, Philadelphia, Pa.

May 26-28—Supersonic Transport Meeting, San Diego Section, Institute of the Aeronautical Sciences, San Diego, Calif.

June 1-3—National Symposium, Institute of Radio Engineers' Professional Group on Microwave Theory & Techniques, Harvard University, Cambridge, Mass.

June 4-5—Third National Conference, Institute of Radio Engineers' Professional Group on Production Techniques, Villa Hotel, San Mateo, Calif.

June 8-11—Semi-annual Meeting and Astronautical Exhibition, American Rocket Society, El Cortez Hotel, San Diego, Calif.

June 12-21—23rd French International Air Show, Le Bourget, Paris, France.

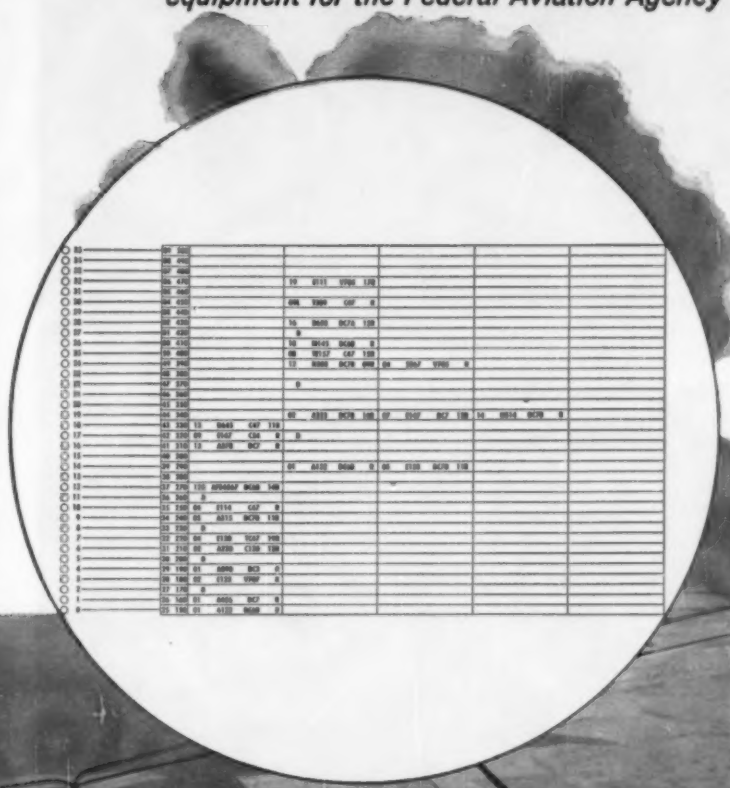
Aug. 31-Sept. 5—10th Annual Congress, International Astronautical Federation, Church House, Westminster, London.

Sept. 7-13—1959 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Oct. 12-16—15th General Convention of the International Air Transport Assn., Tokyo, Japan.

GPL systems management

equipment for the Federal Aviation Agency



GPL's contracts for the FAA's experimental data processing central—the heart of tomorrow's air traffic control system—point up the diverse talents required of an effective systems manager.

As prime contractor for this FAA Bureau of Research and Development project, GPL contributes to the design and assumes responsibility for direction, schedules, plans, budgets, and the performances of nine associated companies. Necessary technical capabilities include broad knowledge of air traffic control problems, computers, data handling, radar, communications, human engineering, and "systems thinking" capable of integrating these varied disciplines into a practical, workable system.

The FAA data processing central is but one of a number of current airborne and ground-based programs reflecting GPL's capabilities as systems manager. Supporting these programs are a "systems" oriented technical organization, a "customer" oriented management, and a complete capability from research, engineering, and manufacturing on through to customer service.

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NASARR is one example of the type of system that is resulting from Autonetics' decade of development in monopulse radar.

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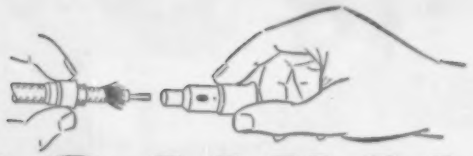

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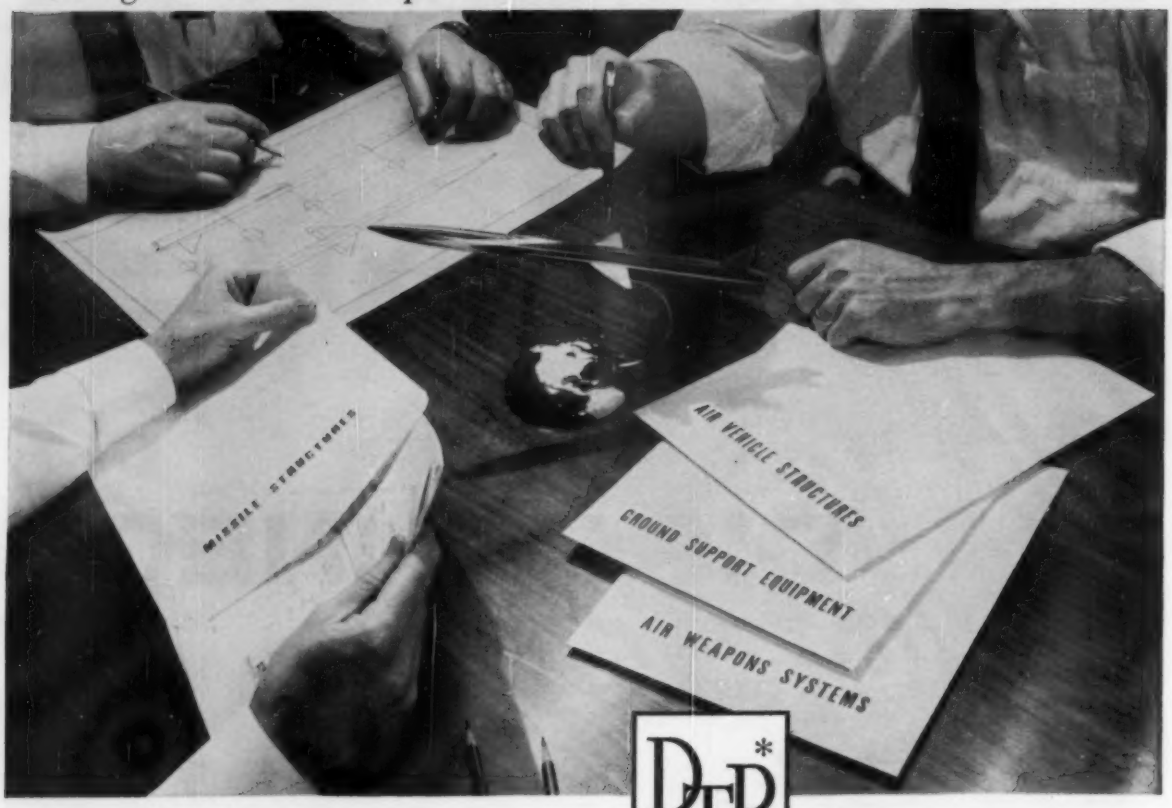

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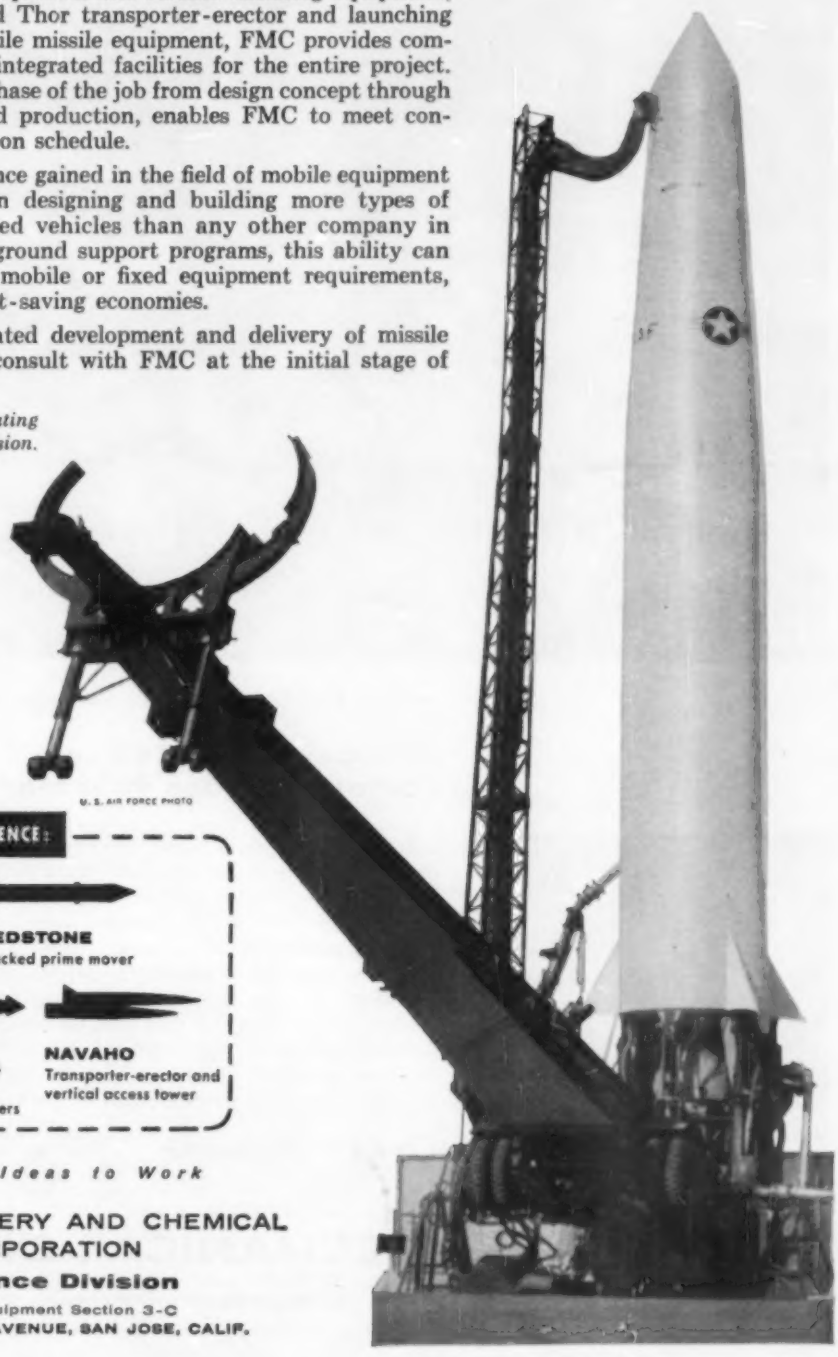
FMC's extensive experience gained in the field of mobile equipment stems from over 17 years in designing and building more types of military-standardized tracked vehicles than any other company in America. Applied to missile ground support programs, this ability can provide the answer to your mobile or fixed equipment requirements, with important time and cost-saving economies.

To assure fully coordinated development and delivery of missile ground support equipment, consult with FMC at the initial stage of project planning.

Creative Engineers: Find stimulating challenge at FMC's Ordnance Division.



THOR transporter-erector, launching base and power trailer delivered by FMC in just eight months—2 months ahead of schedule—receives operational check-out.

U. S. AIR FORCE PHOTO

HERE IS FMC'S PROFILE OF EXPERIENCE:

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Mobile loader vehicle

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BOMARC
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NAVAHO
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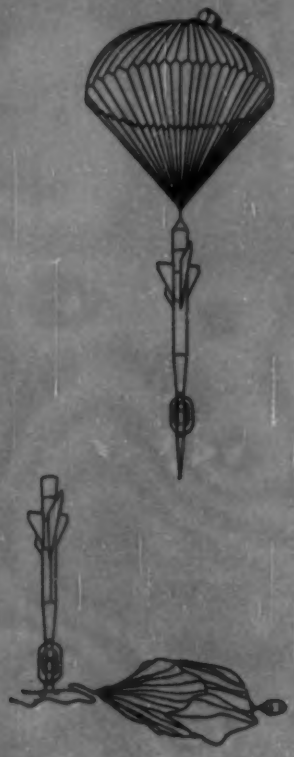

The AIR PROVING GROUND CENTER, located at Eglin Air Force Base, Florida, is one of the test and development centers of the AIR RESEARCH AND DEVELOPMENT COMMAND of the USAF. As part of its overall mission, APGC is responsible for research, development, test, and evaluation of guns and other aircraft weapons, ammunition, rockets, bombs (except nuclear weapons), fire control components and systems. Typical of the development programs being conducted by APGC is the TDU-9/B supersonic tow target. This unique target, designed and produced by Hayes Aircraft Corporation, provides years-ahead capability to the Air Force in the training of personnel in missilery, rocketry, and modern gunnery.

The TDU-9/B target provides realistic simulation of full scale aircraft and missiles. Constructed of sturdy reinforced plastics, the target contains equipment for a number of specialized missions. Included in this equipment are a scoring device, radar tracking beacon, radar augmentation, infrared radiation augmentation, visual augmentation, and a command receiver. The reliable recovery system insures reuse of the target and economical operation. The overall system reflects the technical team work between APGC and Hayes Aircraft Corporation.

The TDU-9/B tow target development is one of several contracts which Hayes Aircraft Corporation has with the Air Proving Ground Center. As such, it is another fine example of the Air Force-Industry team working towards a more secure America.

RESEARCH, DEVELOPMENT & TECHNICAL PERSONNEL are needed by Hayes Aircraft Corporation to participate in modern weapons system and component design and manufacture. With more than 10,000 employees, Hayes is currently active in both missile and aircraft production and is conducting research and development in many diverse fields. We welcome your inquiries. For further details, write to Personnel Director, Department 405, P.O. Box 2287, Birmingham, Alabama.

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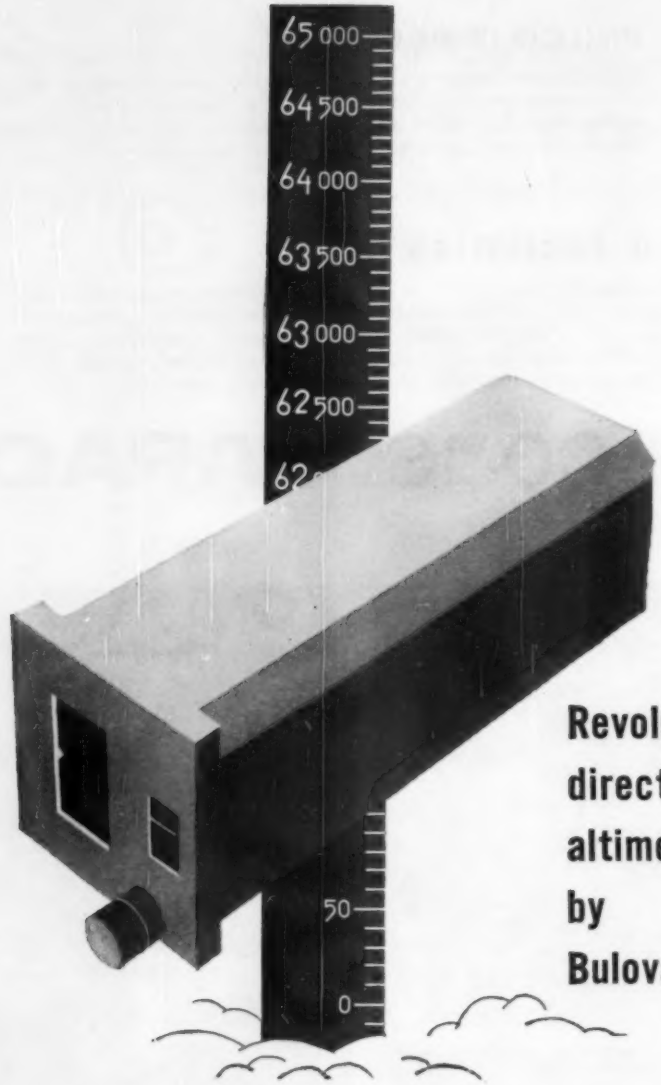

Revolutionary direct-reading altimeter... by Bulova

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key personnel: Sam O. Perry, General Manager • Morgan Wilkes, Western District Manager
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RANGE SYSTEMS DIVISION

FIREBEE···THE HIT OF PROJECT WILLIAM TELL

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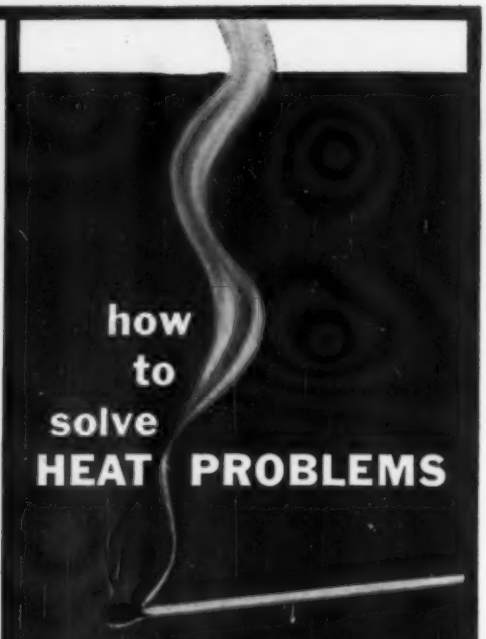
That's the typical reaction of Air Force interceptor pilots after they fired at Ryan Firebee jet targets during the recent "Project William Tell" Weapons Meet.

78 Firebees, launched off the Florida coast, brought combat realism to the 10-day meet. Acting as "enemy" jet bombers, the free-flying Firebees streaked in at over 500 mph, from 14,000 to 42,000 feet, and flew an average of 31 minutes each.

Air Force pilots and weapons systems crews met this realistic test with the most impressive teamwork and skill ever displayed at a weapons meet.



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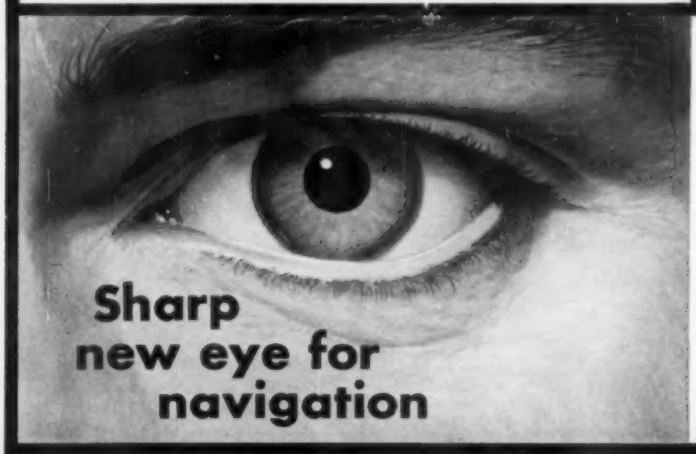
Ryan hot parts are giving outstanding service in turbo-jets, afterburners, prop-jets, ramjets, rockets, and piston engines. That's why Ryan has the answers to high-temperature problems – from hot parts to complete engine packages.



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Developed in cooperation with the Navy, these advanced electronic systems are the lightest, simplest, most compact, most reliable of their type.

This new order, one of the largest of its kind, further emphasizes Ryan's leadership in electronic navigation and guidance systems.

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April 13, 1959

Aviation Week

Including Space Technology

Vol. 70, No. 15
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PICTURE CREDITS

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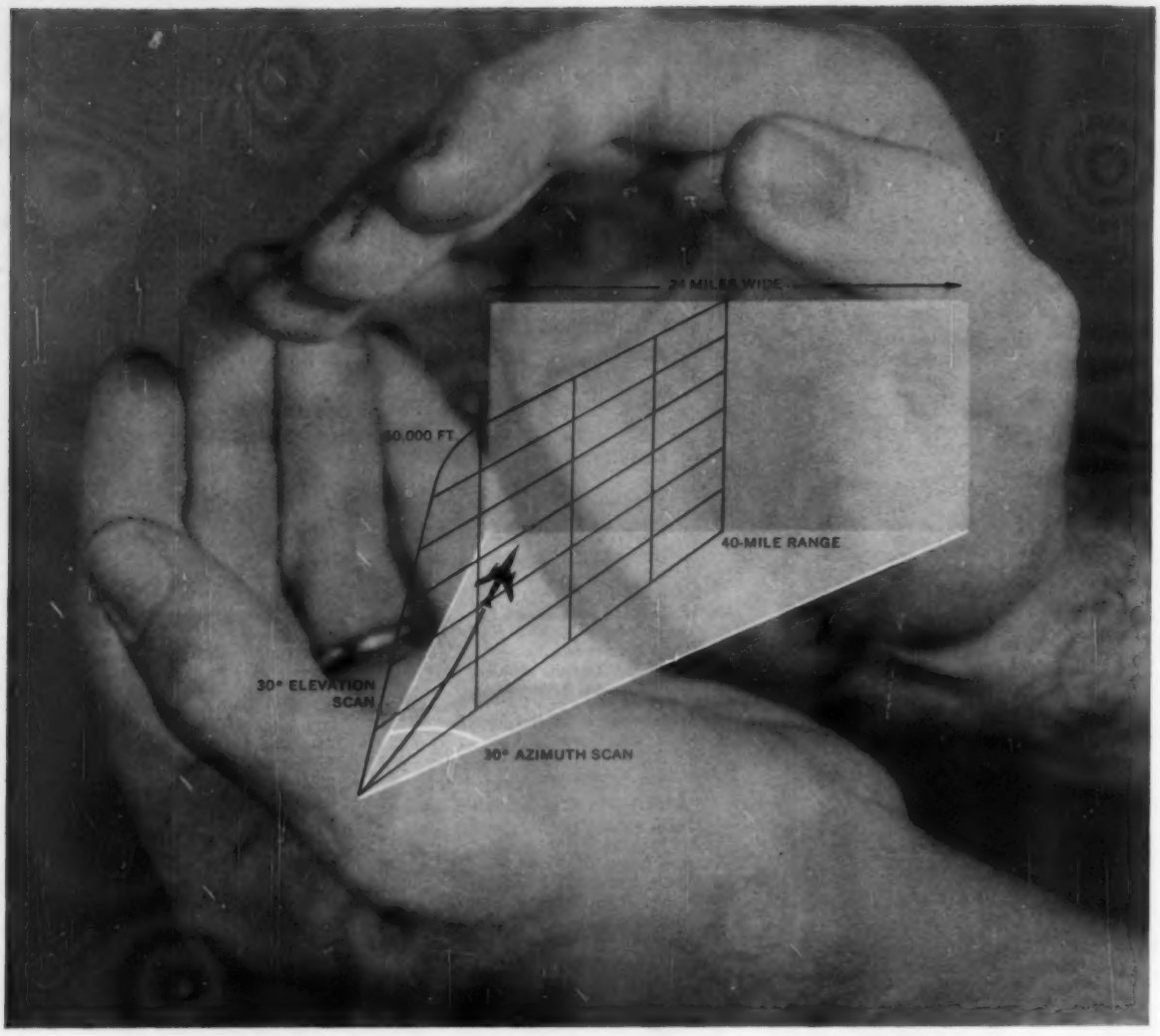

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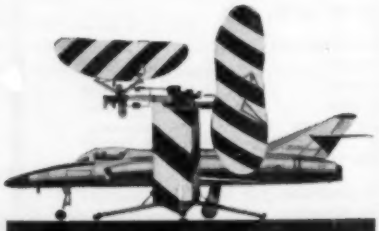

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EDITORIAL

General Power's Blunt Warning

The Fiscal 1960 Defense Department budget is risking the future of the United States by imposing fiscal limitations on the technical, industrial and military capability of this country to modernize its strategic deterrent forces fast enough to maintain a continuous margin of significant superiority over Soviet military strength. This is the blunt warning recently sounded to Congress by Gen. Thomas S. Power, commander of Strategic Air Command (see p. 30).

Gen. Power is probably better qualified in modern military technology and the fast changing factors of the strategic deterrent equation than any other general, active or retired, in this country today. And he is the man who now has the ultimate responsibility to make good in searing thermonuclear combat the promises and boasts made to the American people by political generals and general-politicians.

Gen. Power was one of the first military men to work in combat with atomic weapons during his B-29 command in the Pacific war against Japan. He has participated in the building of Strategic Air Command from its post-war inception and has served with it in various capacities for more than 10 years. He also acquired a rare intimacy with the galloping new technologies and their critical time factors that now dominate military operations during a three year hitch as head of the Air Research and Development Command. He also was one of the first high level USAF officers to visit the Soviet Union and actually see its combat planes, aircraft and engine factories and technical schools and personally meet the men who run the vast Russian military program. Therefore, his analysis of the current and future problems of our strategic deterrent forces in relation to the Soviet Union carries special weight and deserves the detailed attention of the American people in formulating their decisions.

We would like to call special attention to several key points made by Gen. Power that go far to clarify what has been up to now a confusing welter of soothing syrup and glossy generalities dispensed by the Joint Chiefs of Staff during their Fiscal 1960 budget testimony.

These points include:

• **The strategic deterrent of the United States today,** of which 90% is carried in the bomb bays of Strategic Air Command B-47s and B-52s, has sufficient margin of superiority to deter the Soviet Union from major war now.

This is not the issue at stake in the Fiscal 1960 defense budget.

The real issue, according to Gen. Power—and we agree—is that, under the limitations imposed by the budget, our strategic deterrent posture is deteriorating in relation to the Soviet Union and will continue to do so unless these forces are modernized as fast as our abilities permit.

• **This country has the technical, industrial and military** capability to modernize our strategic deterrent forces at a fast enough pace to maintain the required margin of superiority. "I want more B-52s than are in our program, and I want more Atlases and I want them faster and I want more B-58s. . . . I think you are just risking the whole country. That is how important I feel it is. If you do not deter this man (Nikita Khrushchev) as I said before, nobody is going to win a thermonuclear war. . . . The force which is now programed—which I am told by the Pentagon is programed—is not adequate because it is not coming fast enough. I want more and I want it faster. I have so asked for it."

The details of how the B-52 and B-58 bomber production rates have been stretched out due to fiscal limitations and the KC-135 tanker program similarly reduced by budget ceilings has been detailed in AVIATION WEEK before. Defense Secretary McElroy himself confirmed to Congress recently that the Atlas ICBM production rate was being deliberately held to a fraction of its current capacity.

• **The claim that it is possible to safely abandon** significant margins of military superiority and maintain only a precisely calculated "minimum deterrent" is completely false.

"People sometimes ask me what I think the minimum deterrent force is," Gen. Power said. "They ask as though it were a package that one could get at a local store and buy it off the shelf with a price tag on it. I tell these people I don't know what the minimum deterrent is and what is more there is nobody in this world who knows.

"If anybody tells you they know what the minimum deterrent is, tell them for me that they are liars.

"The closest man who would know what the minimum deterrent is would be Mr. Khrushchev and frankly I don't think he knows from one week to another. He might be willing to absorb more punishment next week than he wants to absorb today. Therefore, deterrence is not a concrete or finite amount."

• **A relatively small percentage** of the Defense Department's annual budget is being invested in Strategic Air Command. Gen. Power estimated that only 18% of the dollars, less than 10% of the men and real estate and about 7% of the aircraft now in the defense establishment are in SAC.

These are only a few of the highlights in Gen. Power's testimony it is possible to discuss in this limited space. Consequently, we are publishing the text of Gen. Power's testimony before the House Appropriations Military Subcommittee in the April 20 issue of AVIATION WEEK. We recommend a detailed study of it to our readers as the clearest exposition to date of our basic technical, military and fiscal problems in maintaining an effective strategic deterrent to major war for as far into the future as any man can now see.

—Robert Hotz

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EDISON

oil pressure indicating system withstands vibration to 2000 cps at 20g's

Transmitter is mounted directly on engine and connected to panel indicator and power source by 3 unshielded copper wires.

Indicator is hermetically sealed — requires less than 0.6 watts to operate. When power is off pointer will move off-scale below zero. Available in 1½" and 2" (shown above) sizes. Two-inch size may be integrally lighted.

Designed for use on all new jet engines, the new Edison oil pressure indicating system consists of two components — a transmitter and panel indicator. Because the Model 318 transmitter can withstand vibration to 2000 cps, it may be mounted directly on these engines without shock mountings. As a result, it offers greater reliability, accuracy and speed of response.

Ordinary transmitters must be mounted off the engine and then connected by hose or tubing to engine pressure source. In sub-zero temperatures oil in hose can thicken and false or delayed pressure indications may result.

The new Model 318 transmitter is 50% smaller and 50% lighter (1.0 lb.) than the model 218 developed by Edison in 1956. It will meet requirements of new specification MIL-T-26638.

Its simplified electro-mechanical design makes installation and maintenance easy. Frictionless transmitter has only one moving part and maintains its accuracy in temperatures to 232 C.

For additional information write for publication 3049.

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WHO'S WHERE

In the Front Office

Kenneth W. Erickson, vice president and general manager-Nuclear Division, elected a director, Kaman Aircraft Corp., Bloomfield, Conn. Also: **William R. Murray,** vice president-chief of test and development; **James W. Marshall,** vice president-military contracts; **C. Lester Morris,** assistant vice president-service manager.

G. Carlton Hill and **John M. Lockhart,** directors, Aeronca Manufacturing Corp., Middletown, Ohio. Mr. Hill is president of the Fifth Third Union Trust Co. of Cincinnati, and Mr. Lockhart is vice president of The Kroger Co.

Dr. William Ewart Williams, internationally known physicist, elected a director of Bulova Research and Development Laboratories, Inc., Woodside, N. Y.

Frederick H. Vahlsing, a director, Seaboard & Western Airlines, Inc. He is board chairman of F. H. Vahlsing, Inc.

Eldon M. Bloyd, president and general manager, Dal-Tex Aviation, Inc., Dallas, Tex.

Harry L. Huntsinger, executive vice president, Potter & Brumfield, Inc., subsidiary of American Machine & Foundry Co., Princeton, Ind.

Phillips Eastman, Jr., vice president of a newly created executive department of Hallamore Division of The Siegler Corp., Anaheim, Calif. Mr. Eastman will continue to supervise the Division's Denver, Colo., facility.

Albert T. Camp, assistant vice president and director of research, Grand Central Rocket Co., Redlands, Calif.

Walter C. Cooper, assistant vice president, General Precision Laboratory, Inc., subsidiary of General Precision Equipment Corp., Pleasantville, N. Y. He continues as manager of government contracts.

Honors and Elections

John R. Scull has been appointed scientist for guidance and control in the Office of Program Planning and Evaluation of the National Aeronautics and Space Administration, Washington, D. C. Mr. Scull is on temporary leave as assistant chief of the Electromechanical Development Section of the California Institute of Technology's Jet Propulsion Laboratory, Pasadena, Calif.

Tore N. Anderson, vice president of Airtron, Inc., has been appointed a consultant to the Secretary of Defense, to work with the advisory group on electronic research and development programs for the Army, Navy and Air Force.

Dr. Louis N. Ridenour, of Lockheed Aircraft Corp., has been elected a director of the Electronic Industries Assn., Washington, D. C. Also: **Maj. Gen. W. Preston Corderman** (USA, ret.), of Litton Industries, was elected to the Assn.'s Military Products Division Executive Committee.

Dr. Robert H. Boden, program engineer for ion engine research at Rocketdyne, a division of North American Aviation, has been awarded the Manly Memorial Medal by the Society of Automotive Engineers for his paper, "The Ion Rocket Engine."

(Continued on page 158)

INDUSTRY OBSERVER

► Responsibility for systems engineering and technical direction of National Aeronautics and Space Administration's Mercury man-in-space project has been assigned to Space Technology Laboratories, which also is associated with NASA in the forthcoming Able III 3,000 mi. elliptical orbit satellite and the Able IV Venus probes. McDonnell is building the Mercury capsule.

► **Detection of submerged submarines at ranges beyond 5,000 mi. may be possible as the result of a new type detector under development by Varian Associates with Navy sponsorship.**

► Add Sperry Gyroscope Co. to the list of companies bidding for the inertial guidance system production for use on the USAF-Martin Titan ICBM. Other competitors include AC Spark Plug, Kearfott, Minneapolis-Honeywell and Northrop's Nortronics Division.

► **Decision on choice of contractor to develop Army's Mauler tactical air-defense missile, originally due last month, has been delayed by top-level Army hassle over whether the projected funds should be used instead for acceleration of the Nike Zeus anti-ICBM missile program. Present thinking, however, is that Army will award a contract for the Mauler program, with the final decision due before the end of May.**

► New development plan is being advanced for Advanced Research Projects Agency's WS-117L advanced reconnaissance system. Plan envisages acceleration of the program and a matching expansion of facilities. As many as six Atlas boosters may be diverted from the Atlas program and funneled into the W-117L project this year unless requirements are revised as a result of experience gained from preliminary Discoverer firings which originally were included in the WS-117L project.

► **Lockheed Aircraft Corp. is considering the design of small submarines each capable of carrying a single Polaris-type fleet ballistic missile and a 10-15 man crew in connection with the Puget Sound Bridge and Dredging Co., in which the company recently acquired controlling interest. Lockheed's Marietta, Ga., division probably will participate in submarine projects because of its background in the nuclear field. Lockheed is considering adaption of plated high-strength aluminum alloys as possible structural materials for the submarine.**

► Northrop T-38 jet trainer is scheduled to fly this month from Edwards AFB, Calif., with General Electric YJ85 prototype flight engines. YJ85 is developing a thrust slightly below that specified for operational models of the J85.

► **Long-range plan for Pacific Missile Range includes an anti-missile missile range on which anti-missile missiles would be fired from a Pacific island, probably Kwajalein, against missiles launched from the Naval Missile Facility at Pt. Arguello along the corridor that passes Midway and Wake Island and the Eniwetok atoll. Ballistic missile impact locator facilities will be at Midway, Wake, Eniwetok and in the Hawaiian Islands.**

► Navy's new Lockheed P3V (Electra) will be outfitted with a Doppler-inertial automatic navigation system developed by Litton Industries. Doppler radar, to be provided by Ryan Aeronautical, will minimize accumulation of inertial errors on extended missions.

► **Total of $3.2 million for test facilities for the 1.5-million lb. thrust single-chamber Rocketdyne space booster engine is programed in National Aeronautics and Space Administration's supplemental budget request for Fiscal 1959.**

► Army Ballistic Missile Agency holds about $20 million in contracts from National Aeronautics and Space Administration in the current fiscal year and already is programed for about the same amount in Fiscal 1960. The 1960 total is expected to increase.

LINDE's NEW PLASMARC TORCH SERVICE

Brings Industry Production Parts From Refractory Metals

No other method of fabricating refractory metals can match this. The high melting points of tungsten, tantalum, and molybdenum are no longer a problem. For LINDE's new *PLASMARC* Torch, working in the temperature range between 15,000 and 30,000 degrees K., can coat parts or form shapes of virtually any size or complexity. It's an entirely new way to make such articles as rocket nozzles, crucibles, components for electronic and X-ray use, and parts for atomic energy equipment!

The quality of these pieces is uniformly high. Tolerances can be held to .002 in. or better. The metal loses none of its purity and superior density is achieved.

With the *PLASMARC* Torch, LINDE is equipped to supply you with parts made of, or coated with, refractory metals; or made of a variety of metals combined with non-metals or reinforced plastics. LINDE will also provide a wind-tunnel materials testing service based on this device. For information on this extension of LINDE's well-known Flame-Plating service, write Dept. AW-13, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. In Canada: Linde Company, Division of Union Carbide Canada Limited.

The *PLASMARC* Torch employs a non-transferred electric arc to generate such high temperatures that powder or wire fed into the chamber is literally melted. Inert gases flowing continuously carry the metal particles in a plastic state and deposit them on the workpiece at near-sonic speeds. Jets of CO_2 cool the particles instantly to form heat- and erosion-resistant material. Coatings—even on graphite—have an excellent bond. Shapes are built up on machined mandrels, which are then etched away to leave parts such as those shown above.

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Washington Roundup

Nuclear Plane Decision

Watch for an early decision by the Administration on proposals that it abandon its go-slow weapon system approach in development of a nuclear program in favor of an accelerated project to get a flying testbed into the air.

"Showdown" sessions to reach agreement on the program were scheduled to be held last weekend, preceded by an all-day inspection of the ANP project at the Evendale, Ohio, plant of General Electric. Scheduled participants in the inspection and the sessions included these members of the Joint Congressional Committee on Atomic Energy: Sen. Clinton Anderson (D.-N. Mex.), chairman; Rep. Melvin Price (D.-Ill.), chairman of the Research and Development Subcommittee; Sen. Bourke Hickenlooper (Iowa), ranking Republican Senate member; Rep. James Van Zandt (Pa.), ranking Republican House member; Rep. Craig Hosmer (Calif.), second ranking Republican House member.

Other participants were go-slow advocate Deputy Secretary of Defense Donald Quarles; John A. McCone, chairman of the Atomic Energy Commission; John Floberg, an AEC member; H. B. Loper, assistant to the Secretary of Defense for Atomic Energy; and Air Force Maj. Gen. Donald Keirn, assistant USAF deputy chief of staff for nuclear systems.

Rep. Price, who has spearheaded the congressional campaign for an expedited "fly early" program, originally announced a public hearing for a showdown with Secretary Quarles, who has opposed speeding up the program—unless and until there are technical breakthroughs (AW Feb. 16, p. 32). Apparently it was decided to attempt to work out agreement on a program.

Support From Vinson

Meanwhile, House Armed Services Committee gave its support to Price's nuclear-plane campaign. Following testimony by USAF Secretary James H. Douglas, committee chairman Rep. Carl Vinson (D.-Ga.) declared that "the 37 members of the committee and the country at large" are "very much concerned." Asked the most significant Soviet airpower developments in addition to its ballistic missile progress, Douglas replied:

"Most interesting to us is the development of an advanced bomber which appears to be a supersonic bomber. What they do with this development is, of course, very important. We can't tell today whether this bomber is going into production in an important way or not. But they have moved into a bomber that is supersonic and it has been suggested by some examining of the information that is available on the subject that this might represent a step in a nuclear-powered aircraft program." In an exclusive story last Dec. 1 (p. 27), Aviation Week reported that the prototype of a nuclear-powered bomber is being flight-tested in the Soviet Union.

Soviet Effort vs. U. S.

Soviet Russia's total annual military effort is "roughly equivalent to our own," even though the Soviet Union's gross national product is "now less than half our own," Central Intelligence Agency Director Allen W. Dulles said last week. Dulles said Russia is devoting about twice as much of its gross national product to military ends as the U. S., giving it the highest proportion in the world.

Although "our military posture is stronger and our ability to inflict damage is today greater than that of the Soviet Union," Dulles said, the Russians "will feel that their own foreign policy can be somewhat more assertive" as their military capabilities and nuclear power grow. Russia hopes "eventually to be able to hold the U. S. under the threat of nuclear attack by intercontinental ballistic missiles while they consolidate their position in the fragile parts of the non-communistic world," Dulles said. ". . . In 1956 during the Suez crisis, we had the first Soviet missile rattling as a new tactic of Moscow diplomacy." Soviet industrial growth rate for seven years through 1958 was 9.5% vs. 3.6% for the U. S. in seven years through 1957, he said. If 1958 is figured into the U. S. average, the comparison is "even less favorable" for the U. S.

Union Dispute

Airline Stewards and Stewardesses Assn. is considering severing all ties with its parent union, the Air Line Pilots Assn. The union charges that ALPA failed to back last year's strike by Lake Central Airlines' stewardesses and that union raiding at Mohawk Airlines has been carried out by another ALPA-chartered union, the Airline Agents Assn. At ALSA's recent Chicago convention, delegates passed a resolution empowering its president to formally disaffiliate with ALPA if the pilots' union fails to offer more satisfactory interunion cooperation.

Used Aircraft Report

Public distribution of the Air Coordinating Committee's report on used aircraft was still being withheld late last week because of inability of the group to reach unanimity on airworthiness and liability issues. Two points pertain primarily to aircraft sold overseas, a market that is expected to help dilute surplus supplies within the U.S. Concern over technical airworthiness standards applies primarily to used military aircraft sold abroad. Second problem arises from the question of where liability should rest in the event of an accident of an aircraft with U.S. registration leased to foreign operators. Chances are strong that the two issues will delay distribution of the report for some time to come.

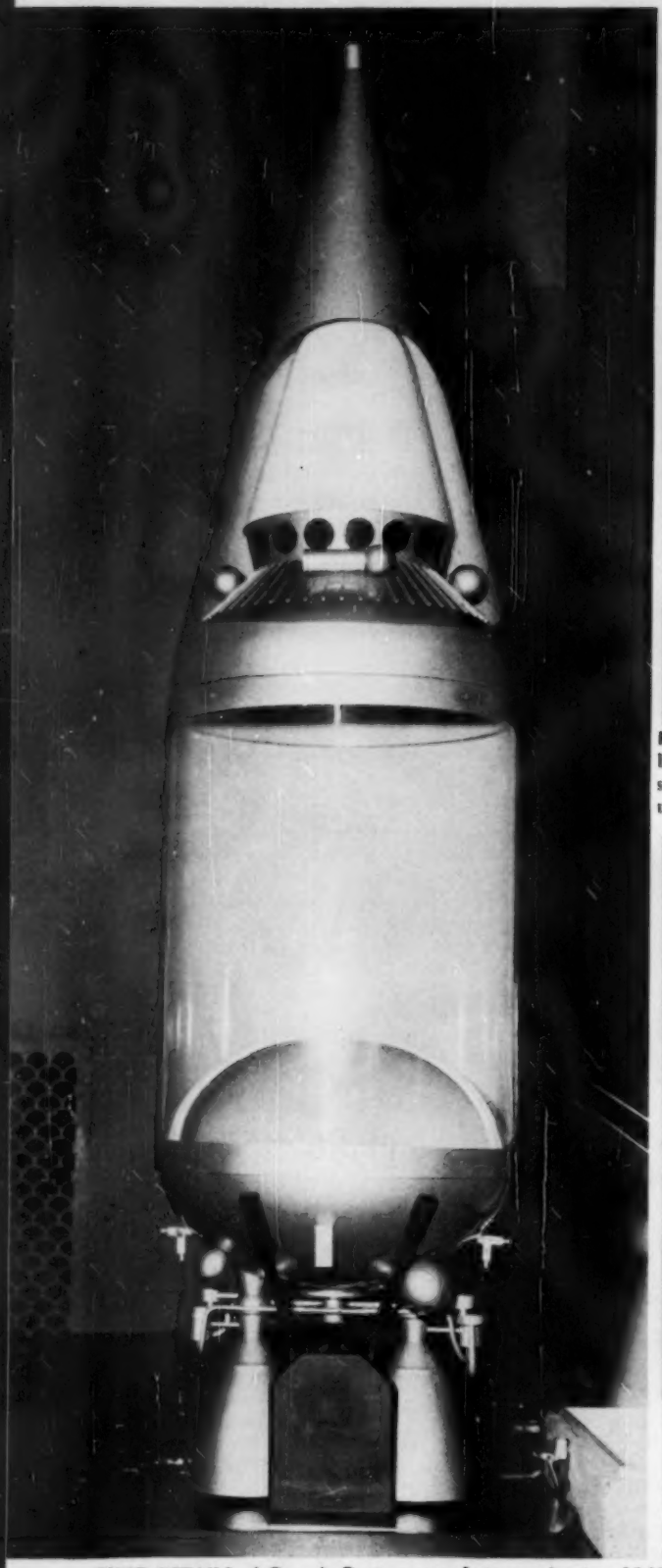
New Look at Small Business

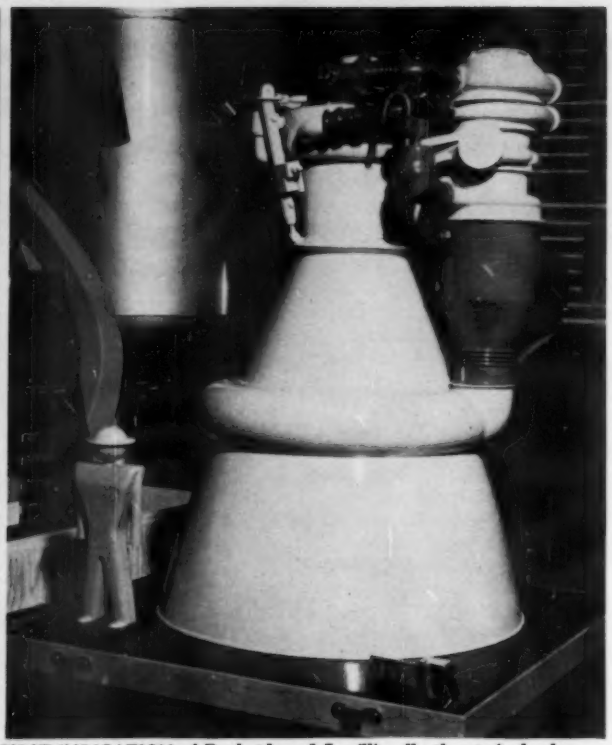
Small Business Administrator Wendell Barnes is scheduling an April 23 open meeting in Washington to hear arguments as to whether government small business benefits should be extended to firms with 1,000 or less employes. Present official definition only takes firms with 500 or less workers.

FAA Vacancy

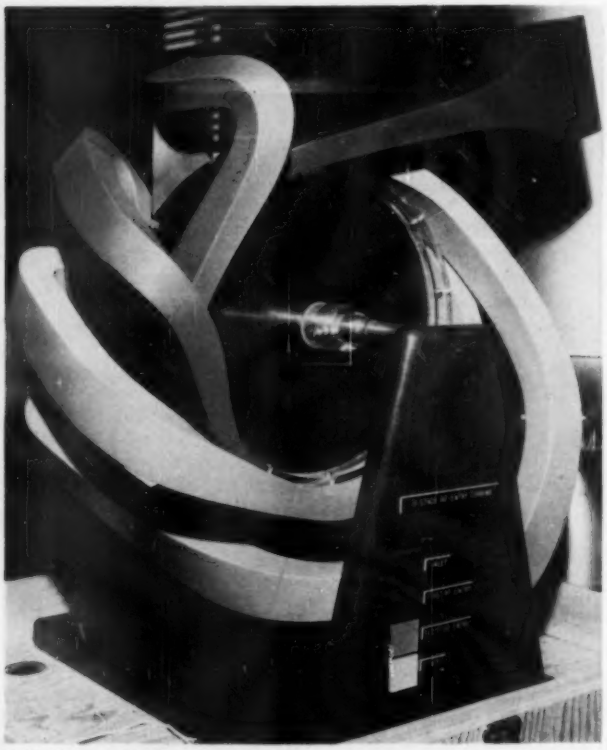
Top post in Federal Aviation Agency's Office of Public Affairs has not yet been filled despite the fact that Preble Staver, who has been heading the office as acting chief, will leave FAA this week to join the Missile Division of Lockheed Aircraft in Sunnydale Calif. Meanwhile, serious consideration was being given to the naming of William S. Lampe, editor of the Pittsburgh Sun-Telegraph, as a consultant to the FAA for public affairs although no official action has been taken as of late last week.

—Washington staff

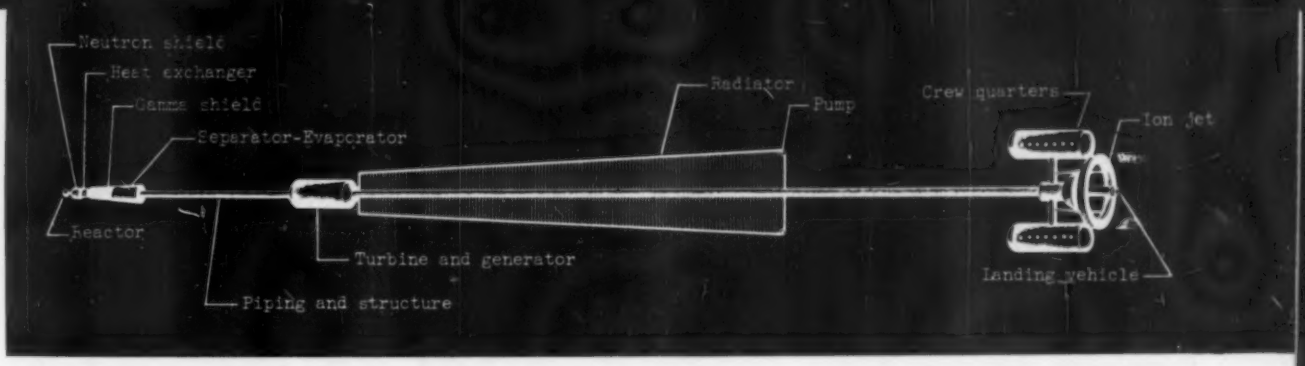




FIRST INDICATION of Rocketdyne 1.5 million lb. thrust single chamber engine size was given by model (above) at NASA hearings. Three-stage turbopump for nuclear rockets (below) under study by NASA uses single rotor, passes gas through it three times.



FIRST DETAILS of Convair Centaur second stage, using two 15,000 lb. Pratt & Whitney liquid hydrogen engines, as shown to Congress last week by National Aeronautics and Space Administration. First stage is Atlas, later third stage will be storable.



MARS VEHICLE studies by National Aeronautics and Space Administration's Lewis Research Center indicate that nuclear turboelectric power would provide great weight saving over chemical powerplant for same mission. System would produce 12,000 kw. and 58 lb. of thrust, allow for several months' manned exploration. Heavier powerplant would cut trip from 1,060 days to 600 days.

Space Technology

NASA Details Space Missions, Needs

Fourteen satellites, six probes programed by end of 1960; propulsion projects for space outlined.

Washington—National Aeronautics and Space Administration last week outlined to Congress the missions for 14 satellites and six space probes that it plans to launch by the end of 1960 and discussed rough timetables and uses for chemical, nuclear and electric propulsion systems now being developed.

Highlights of the testimony—presented to a subcommittee of the Senate Aeronautical and Space Sciences Committee, which is attempting to build a comprehensive record of the current and future national space program:

• **Long-range plan to put** a scientific observatory on the moon and more immediate plans for extensive surveys of the atmospheres and surfaces of the moon, Mars and Venus by means of orbiting space probes.

• **Plans to put a 5,000 lb.** meteorological satellite, a "stationary" communications satellite and a two-man space ship into orbits, using a vehicle due to be ready for first firings by late next year.

• **Prediction that an ion** engine with "reasonable efficiency and reasonable amounts of thrust" may be in operation within three-and-a-half to four years and optimistic reports on electric propulsion systems in general.

• **Disclosure that NASA** has asked Atomic Energy Commission to develop Snap VIII, a reactor power system that would produce the electrical energy necessary for an electrical propulsion system. Snap VIII would produce 10 times the power produced by the existing Snap II on which it is based.

• **Plans to orbit an astronomical** observatory, possibly as early as one to two years from now.

• **Plans for the first international** cooperative space venture—a Canadian satellite launched by a U. S. vehicle—to explore ionosphere from its upper side.

NASA witnesses gave these new details on two of the first new vehicles that will be available for space work:

• **Scout.** This low-cost solid propellant rocket (AW Mar. 16, p. 26) will send a 1,000 lb. payload to a distance of 12,000 mi. or a 500 lb. payload to 25,000 mi. from earth. It can be used to put satellites in circular polar orbits at 1,200 mi.; orbits with 200 mi. perigees and 8,000 mi. apogees at various angles to the equator or orbits with 200 mi. perigees and 15,000 mi. apogees if the orbit is near-equatorial so that advantage is taken of the speed of the rotation of the earth. Scout also can be used to put up better cloud cover satellites, early communications satellites and experimental satellite stabilization systems. It also will be used to test scaled versions of missile nose cones, manned capsules and advanced Dyna-Soar concepts, and as a vertical probe. Fiscal 1960 budget includes $2 million for Scout. Scout's first stage uses improved fuels from late in the Polaris missile program, and the second stage draws on the Minuteman missile program's technology. In the four-stage version, guidance will be carried in the third stage. Fourth stage will be spun for orbital missions.

• **Vega.** Fiscal 1960 budget includes $42.8 million for Vega. Intial two-stage version consists of a production model Atlas with its upper end widened to the full 10 ft. diam. plus a stage that draws heavily on the Atlas, using the same tooling, and powered by a General Electric Vanguard engine with longer nozzle and restart capability. Engine is due for delivery by late fall. Second stage will be about 13 ft. 4 in. long. Later third stage, powered by a 6,000 lb. thrust storable engine being developed by NASA's Jet Propulsion Laboratory, will consist almost solely of tanks and nozzle, and it and the payload will be housed under the anti-drag nose cone. Over-all vehicle length will be 96 ft. Vega will use the same launch sites and test equipment as Atlas, and first firings are due late in

Interplanetary Probes and Payloads*

Type mission	Booster Vehicle	Payload
Initial planetary probes	Thor-Able	50 lb.
" " "	Atlas-Able	200 lb.
" " "	Vega	1,300 lb.
Venus, Mars near-miss	Vega	1,300 lb.
Venus, Mars unmanned orbit	Vega	260 lb.
" " " "	Juno V	900 lb.
" " " "	Nova	15,000 lb.
Venus, Mars atmosphere entry	Vega	1,300 lb.
Solar probe, Jupiter near-miss	Juno V	1,900 lb.
Venus, Mars landing	Juno V	400 lb.

* Based on testimony by NASA scientists.

Lunar Probes & Payloads*

Type Mission	Booster Vehicle	Payload
Lunar near-miss	Juno II	15 lb.
Lunar impact	Thor-Delta	100 lb.
Unmanned lunar orbit	Thor-Delta	65 lb.
" " "	Vega	980 lb.
Lunar rough-landing	Thor-Delta	50 lb.
" " "	Vega	650 lb.
Lunar soft-landing	Vega	430 lb.
" " "	Atlas-Centaur	730 lb.
" " "	Juno V	1,700 lb.
" " "	Nova	19,900 lb.
Unmanned orbit with instrument return	Atlas-Centaur	275 lb.
" " " " "	Juno V	700 lb.
Lunar soft-landing with return of sample	Juno V	200 lb.
† Manned lunar landing and return to earth	Nova	2,100 lb.

* Based on testimony by NASA scientists.

† Assumes use of additional freight rockets to supply and support man after lunar landing.

1960. Missions will include putting a 5,800 lb. meteorological satellite in a 300 mi. orbit, where it will observe weather for six months to a year; putting a 740 lb. communications relay satellite in a 22,400 mi. orbit; putting a television-equipped payload in orbit around the moon for an extensive survey of its surface; sending 1,000 lb. payloads to Mars and Venus for similar surface surveys; putting a two-man successor to the one-man Mercury capsule into an earth orbit for a stay of one or two weeks.

NASA Administrator Keith Glennan disclosed that the Fiscal 1960 budget contains $41 million for the three-stage Centaur vehicle (Atlas high-energy-storable) and $13.3 million for Thor-Delta, a Thor-Able vehicle with a coasting guidance control and radio guidance system added.

NASA Witnesses

NASA witnesses were optimistic about the promises of nuclear and nuclear-electric propulsion systems, and said the nuclear turboelectric systems "are currently the most promising type for intensive development."

Major problems still are in reactor development. Initial uses for electric engines probably will be for orientation and orbit control of astronomical, communications and meteorological satellites. Later, they will be used to power vehicles for trips as far as the outer reaches of the solar system.

Chief competitor for space power systems is solar energy, and the main problem there is development of solar collectors that are light enough but large enough and strong enough to be useful. Nuclearelectric systems now have quite an edge over solar schemes but both are being developed, witnesses said.

Asked for a prediction on when ion and plasma rockets would be available, J. Howard Childs, chief of the electric propulsion branch at the Lewis Research Center, said, that just as "a guess" he believed that "perhaps we could have ion rockets in operation that have reasonable efficiency and give reasonable amounts of thrust in, say, three-and-a-half or four years. The plasma rocket looks like it will take longer to develop." Instrumentation for measuring efficiency and exact quantitative performance of plasma accelerators is still being developed.

One ion engine model now being built at Lewis will produce one-tenth of a pound of thrust—enough to be "of interest on satellites for adjusting the orbit and for attitude control," Childs said. It will be tested in "rather elaborate large vacuum tank facilities" now being built at Lewis. The first tank began operation in mid-January.

Studies of electric and nuclear-electric engines indicate considerable weight savings for more ambitious space missions, in spite of the great weight to thrust ratios of the systems that result from heavy electricity-producing machinery.

A 600-ft., eight-man nuclearelectric vehicle that would be assembled in an earth orbit, travel to a Martian orbit, and send men down to the plane in an auxiliary craft for several months of exploration was described, and comparisons made for handling the task with chemical and non-chemical systems. The vehicle would produce 12,000 kw. of power but only 58 lb. of thrust.

If high-energy chemical engines were to power the vehicle on its planet-to-planet trip, then some 2.4 million lb. would have to be launched from earth into the earth orbit for assembly. Only 200,000 lb. of this would be initial payload—the rest being almost all propellant. With the turboelectric system, however, only 400,000 lb. would have to be put into the earth orbit—and 200,000 lb. of it would still be initial payload.

To put the components of the chemically-powered Mars vehicle into earth orbit for assembly by using the 1.5-million lb. thrust conventional engine now under development, would require 100 launchings. The same rocket could put the non-chemical vehicle's components into orbit with 16 launchings. Similar comparisons for other boosters are: six-million lb. cluster, 24 launchings for chemical vehicle, four for non-chemical; 24-million lb. cluster, six launchings for chemical vs. one for non-chemical.

Over the long period needed for a Mars exploration and return, the low-thrust electric system compares well with the high-energy chemical system for travel time—973 days round trip for chemical vs. 1,060 for electric. This is with a 350,000 lb. vehicle and a weight to thrust ratio of 5,000 for the electric system, the least-total-weight mission. Increasing the weight of the vehicle to 450,000 lb. and decreasing weight-thrust ratio could cut the trip to about 540 days.

The 350,000 lb. vehicle described allows 50,000 lb. for the cabin including communications, navigation and environment equipment and crew; subsistence allowance of food, water and oxygen of 85,000 lb.; landing craft and exploration equipment, 40,000 lb.; powerplant, 76,000 lb.; propellants, 70,000 lb.; receivers, 29,000 lb.

Nuclear Rocket Engines

Nuclear rocket engines using hydrogen as a fuel also surpass chemical systems for many space missions, at least in theoretical studies, witnesses said. Goals are specific impulses up to 1,200 at temperatures of 6,000F, and thrust to weight ratios of about 40 compared to 100 for chemical. With specific impulses of 800, which seem more possibly attainable, propellant fraction might be 70 to 72%. Structure and tankage weight is about the same for chemical and nuclear rockets.

Earth satellite weighing 30,000 lb. could be launched into a 300 mi. orbit by a one-stage nuclear rocket, 17 ft. in diam. and 170 ft. long, and weighing about 210,000 lb. To do the same with a chemical system would require a 170 ft., 21 ft. diam., three-stage vehicle weighing 1.2 million lb. This is "a mission we are interested in" for nuclear rockets, Harold B. Finger, chief of NASA's nuclear engines program, testified.

A 30,000 lb. Mars probe launched from an earth orbit could have a 2,200 lb. payload if powered by conventional chemicals; 8,000 lb. if powered by high energy fuels; and 11,500 lb. if powered by a nuclear rocket. This is for

a minimum energy trip, which would take about three years. For a short, high-energy trip, the nuclear has an advantage over chemical 8 to 1 as regards payload.

A 150,000 lb. space ship, which could be put into an earth orbit by the Nova 6-million lb. thrust vehicle planned by NASA, could deliver a 55,000 lb. payload to Mars and return 25,000 lb. if it were nuclear powered. The same ship could deliver only 7,500 lb. payload to Mars and could return only 750 lb.; so it could not be manned. It also would have three or four stages vs. one for the nuclear craft.

Atmospheric Research

NASA's atmospheres research program for the next two years involves 14 to 17 major satellite experiments, six or seven space probe experiments and some 200 sounding rocket experiments. It is aimed at exploring atmospheres of several planets as well as that of earth. Major projects, by research areas, include:

• **Atmospheres program.** Within the next two years, probes to Venus and Mars, a probe to the moon's atmosphere and into interplanetary space, three satellites to probe the earth's atmosphere, including one Vanguard due to be launched in the near future; 40 sounding rockets in 1959 and 100 in 1960 to explore the atmosphere 50 and 100 mi. up; 40 rockets for exploration below 50 mi.

• **Ionospheres program.** Within two years, five earth satellite experiments, one space probe experiment out to many earth's radii and several sounding rockets. Short range goals are studies of ionospheric structure above 200 mi.; very low frequency radio propagation along magnetic lines of force; cosmic noise in the outer atmosphere; interaction between charged particles and spacecraft. Long-range program calls for studies from above and within planetary ionospheres, and NASA is "seriously considering" a propagation observatory on the moon to study cosmic noise, propagation through the earth's ionosphere and possibly as a relay for low frequency radiation.

Ionospheres program includes an "ionospheric topside sounder"—the Canadian satellite. Canada, with very special communications problems because of its geographic location, will invest 20 man-years in ground stations, rocket-borne equipment, etc., and the U. S. will supply the vehicle. The satellite will bounce signals into the ionosphere, receive them on their return and relay information to earth. Simultaneously, ground stations will bounce signals from the underside.

• **Energetic particles.** Within 18 months, four satellite, three space probe and 12 rocket experiments. These will include investigations of cosmic ray intensity in outer space; cosmic ray fluctuations; cosmic ray energy and charge spectrum; great radiation belt's composition and extent (two satellites and four rockets), and auroral particles.

• **Gravitational field program.** Two-year gravitational field program will include a satellite carrying an atomic clock to test Einstein's theory of relativity and a geodetic satellite (see below). Relativity satellite will orbit 4,000 to 5,000 mi. out from earth. If theory is correct, the clock in the satellite should run faster than a similar one on earth because it is less under the influence of earth's gravitation.

• **Magnetic field program.** Within 18 months, two satellite experiments on magnetic storm currents; one polar satellite to explore earth's magnetic field; a probe to explore earth's and moon's magnetic field; some 30 rockets to study ionospheric currents and check instrumentation for satellite experiments; "hitch-hike" experiments in two satellites and two probes to study interplanetary and planetary magnetic fields.

• **Astronomy program.** Telescope may be put into an orbit well above the earth's atmosphere sometime within a year or two. Long-range goal is a telescope on the moon.

Immediate goals include rocket firings, especially from the southern hemisphere, to explore ultraviolet, gamma ray and X-radiation. More ambitious goals are capture and analysis of meteors and meteorites, sampling of surfaces of the moon and planets, electromagnetic analysis of cosmic rays and corona of the sun, and determination of the origin and extent of the universe.

Other scientific satellites due for launching in the next 18 months include:

• **Geodetic satellite.** 21-in., 100 lb. circular satellite outfitted with high intensity discharge lamps which will make it visible to photo-theodolite cameras, should be in orbit within 18 months. Earth-based measurements of geodesy satellite position will make it possible to correlate position of the U. S. and European continental geodetic survey networks to an accuracy of perhaps 60 to 100 ft., NASA's Benjamin Milwitzky predicted. This is important for accurately determining position of targets for ballistic missiles. Contract for development will be announced shortly, AVIATION WEEK learned.

• **Meteorological satellites.** By midsummer, NASA hopes to orbit a satellite designed to measure the heat transfer to and from the earth. Satellite will carry four small spheres, each mounted on the end of a satellite telemetry antenna. Each sphere will be suitably coated and oriented so that one absorbs all solar energy that strikes it, another reflects all solar energy, a third views only solar radiation and the fourth views only heat radiated by the earth. NASA also is taking over a cloud-cover measurement satellite originally developed for Defense Department, which includes both television and infrared scanning devices.

Timetable

Asked for estimates of when it might be possible to achieve a world-wide network of meteorological, communications satellites, NASA scientists estimated:

• **Meteorological satellites** network: 10 years.

• **Fixed communication satellites** (in 22,400 mi. orbit): five to six years.

Milwitzky predicted that navigation satellites equipped with radio/radar beacons might replace all existing long-range navigation systems in the not-too-distant future. He said it also appears feasible to use navigation satellites to automatically correct for accumulated errors in inertial navigation systems, such as those used on long-range aircraft, submarines and ships.

Satellite Schedules

Washington—Next satellite to be launched by U. S. will be joint Army Ballistic Missile Agency/International Geophysical Year vehicle containing nine different scientific experiments. The satellite, shaped like a toy top to achieve maximum gyro stabilization effect from its spinning motion, will include measurements of:

- **Radiation intensity.**
- **Cosmic ray intensity.**
- **Micrometeorite density.**
- **Magnetic field strength.**
- **Electron density.**
- **Astronomical unit to greater precision.**
- **Ionosphere characteristics.**
- **Performance of solar cells without micrometeorite shields.**

Scout Bids

Twenty to 25 firms have submitted proposals for the structures and assembly contract for National Aeronautics and Space Administration's Project Scout vehicle. Bids closed Mar. 20 and a decision is expected by May 1.

Companies included Grumman, Republic, North American's Downey Division, Lockheed's Missiles and Space Division, Douglas-Santa Monica, Aeronautronic Systems, Inc., AMF, Martin, Curtiss-Wright and Chance-Vought. Chance-Vought, anticipating the competition, had submitted 12 voluntary proposals incorporating similar vehicles before the formal competition began.

Power Warns SAC Ability 'Deteriorating'

By Ford Eastman

Washington—Principal U. S. deterrent to nuclear war—the massive retaliation capability of the Strategic Air Command—is rapidly "deteriorating," SAC commander Gen. Thomas S. Power, warned Congress in executive testimony released last week.

Rate of deterioration, Gen. Power told the House Subcommittee on Defense Appropriations, will depend upon U. S. progress in relation to that of the Soviet Union. At present, he added, "it is a neck-and-neck race, and it behooves the U. S. to assess the position of the opponent and then take whatever necessary action is required to cross the finish line first."

The SAC commander told the subcommittee he needs more manned bombers and more intercontinental ballistic missiles and at a faster rate than he is now scheduled to receive them. Major causes for concern as outlined by Gen. Power, include:

- **Gradual increases in Soviet** defense capabilities makes SAC's job of penetration more difficult and boosts Russia's confidence that it can strike with relative impunity.
- **"Fantastic" compression** of warning and reaction time. Gen. Power pointed out that it is now possible to destroy a nation with nuclear bombs in hours and that, in the very near future, this can be accomplished with ballistic missiles within a matter of minutes and with very little warning.
- **Compression of warning** and reaction time increases the problem of survivability of SAC's striking forces.

Gen. Power said that, at present, the U. S. has an adequate margin of deterrence. He added, however, that he could not guarantee that this will hold true during the next two or three years, and he cautioned that the moment the Soviet Union thinks it can attack the U. S. without receiving major retaliatory damage in return "we will get it in the next 60 seconds."

Gen. Power was emphatic as to the action needed to correct the situation. Testimony included:

- **Rep. George H. Mahon,** subcommittee chairman—"Can we afford to rely on the B-47 and the B-52 and the more or less modest budgetary program for the building up of additional striking power? That is the question. Shall we try to do something more about it than we are doing?"
- **Gen. Power**—"If you are asking me, the answer is 'yes.' I want more B-52s than are in the program, and I want more Atlases—and I want them faster—and I want more B-58s."
- **Mahon**—"I know you want them, but is it sufficiently important that we do something about this?"
- **Gen. Power**—"I think you are just risking the whole country. That is how important I feel it is. If you do not deter this man (Soviet Premier Nikita Khrushchev), as I said before, nobody is going to win a thermonuclear war. So it's a tremendous challenge to stay out of it."
- **Mahon**—"We have the B-47s and quite a number of B-52s and a few missiles. Will that be adequate for this period of two or three years?"
- **Gen. Power**—"Your adjectives do not pin it down, but I will pin it down. The force which is now programed—which I am told by the Pentagon is programed—is not adequate because it is not coming fast enough. I want more, and I want it faster. I have so asked for it."

Major share of the deterrent posture of SAC today, Gen. Power told the committee, rests in the Boeing B-47 intermediate-range bomber. The B-47, he added, is a nearing obsolescence, "and it is approaching the state of being obsolete. It can't last forever and to modernize an obsolescent airplane is quite a problem.

Partially Solved

"We have solved that problem to some degree," (AW Dec. 15, p. 71) he said, "but when you start beefing something up, you merely prevent it from breaking there and you do not know whether you are just passing it somewhere else down the structure.

"We have arrived at estimates of the life of this airplane. This is one thing which is nobody's fault. High-speed jet operation is a new art. There isn't any background. There are no textbooks to which you can go to get the answers. Some very comprehensive tests have been run. They are not conclusive and are not finished. They are continuing.

"What can we replace the B-47 with? We can replace it with B-52s, B-58s and (ICBM) missiles. We should replace the B-47s as fast as we can in order not to have our deterrent posture deteriorate."

In response to a question as to whether he was familiar with the Convair Atlas ICBM, Gen Power replied:

"Yes. The Strategic Air Command will operate the Atlas. It is our weapon system. Also, I was in command of the Air Research and Development Command for three years, where we started the Atlas and had the responsibility for it. So I think I do know something about it.

"You asked the question, I believe, should we defer action on the Atlas or have a reduced program because the Minuteman looks better and is coming in in a little later time period. I will give you a direct answer. I think you should produce the Atlas at the maximum logical practical rate, because you are going to get it first. It is the only ICBM weapon system that has really fired up to now and it is a good weapon. It is almost a proven weapon. It has had a very successful R&D. But read the papers, and you would think the missile had been unsuccessful. Actually, it has been more successful than we ever expected it to be. It has had a very high degree of success.

"I think we ought to get it as fast as we can, and get it in hardened sites. I think it is a very good deterrent weapon system."

Present Defense Department program calls for Convair to produce the missile at approximately less than half the rate for which it has the capability. Referring to the solid-propellant Minuteman multi-purpose ballistic missile now in the development stage, Gen. Power told the subcommittee:

"Due to the fact that they are cheap and require very few people around them, we can get them in large numbers. Then it becomes mathematically impossible for an aggressor to destroy them all, and you will always survive with a percentage high enough to strongly deter him. That is the philosophy of it." He also said the possibility of placing the Minuteman upon railroad cars to give them a defense mobility is being considered.

Gen. Power, however, recommended against leapfrogging the Martin Titan ICBM or purchasing limited numbers of the Atlas while awaiting development of the relatively cheaper Minuteman. He said the Titan will be essential to SAC operations because of the increased yield and increased distance, something that could become tremendously important. There will be ample targets, he said, for the yield and the accuracies of the Atlas and Titan.

The other systems which Gen. Power said he thought shoiuld be phased out in addition to the B-47 are the conventional Boeing KC-97 tanker and the Fairchild Goose and Northrop Snark missiles. The Goose ground-launched electronics countermeasures missile program already has been canceled.

The air-breathing, subsonic Snark, he said, has very little value to SAC. It has, he added, "a very poor reaction capability" and could not be launched

Army's AO-1 Mohawk Makes High-Speed Taxi Runs

Grumman Aircraft Engineering Corp.'s Army AO-1 Mohawk made high-speed (full power) taxi runs last week prior to first flight. The turboprop high-speed reconnaissance aircraft has a 59-kt. stall speed. The airplane is designed for short takeoffs and landings.

unless there was sufficient warning time.

Air Force representatives told the committee that a total of $714.1 million had been programed for the Snark system through Fiscal 1959 and that estimated obligations amounted to $668.2 million.

In allocating additional funds to obtain sufficient deterrence for the immediate future, Gen. Power said he would give top priority to the Boeing KC-135 jet tanker and the B-52G—the Hound Dog missile weapon system. At the same time, however, he added that sufficient funds also must be provided for missile procurement.

Gen. Power said that other important items in addition to procurement which must not be under-funded include operations and maintenance, spare parts and support equipment. He also said he would like to have alert pay for his crews which would cost about $15 million a year and more spot promotions which would run about $5 million.

Other SAC Steps

Gen. Power told the committee that other steps which are being taken, or should be taken, to further increase SAC's capability, include:

• **Tightening our defenses** against sabotage. "If an aggressor thinks that through saboteurs he can pin down the retaliatory force just prior to launching a surprise attack and thus catch them on the ground and neutralize or destroy them, this approach becomes very attractive. We do feel, however, that we can protect our alert airplanes. We are determined to do that, and also to protect our control centers, two vital elements of our business."

• **Hardening missile bases** for the obvious reason that they will have to ride out the attack. "The first squadrons of Atlas will be in soft sites. Then we will harden to 25 lb. to the square inch. It will be feasible to go to 100 lb. per square inch, and I think we should get to that degree of hardening as rapidly as we can, in a logical fashion. It will not withstand a direct hit by a hydrogen bomb, but by being able to absorb a near-miss, you place a tremendous penalty on the aggressor. He must plan many missiles against each missile site to have a 90% confidence factor that he will destroy it. Also, we must 'back up' communications so that if the enemy destroys one form of communications we are not completely cut off. In addition, I must have the warning which will come only through good communications. By 'backing up' I mean to place alternate communications outside the limit of the base, so that one bomb could not destroy the whole thing. We have a new system programed which will be a dramatic step forward. I hope it will be funded and carried through."

• **Dispersing the SAC force** "for the obvious reason that, as we spread the force out, we increase the target system of a potential aggressor and thereby lower his confidence factor that he can strike all the retaliatory forces simultaneously. By spreading out the force, we dramatically improve our reaction capability since more planes can take off at the same time."

"The real backbone of SAC's deterrent posture," Gen. Power said, "is our alert system. We maintain a certain percentage of the command on the alert 24 hr. a day, every day in the year. If the force gets a 15 min. warning for which it is tailored, we can get those airplanes off the ground. Therefore, even though an aggressor launches missiles against the U. S.—and nothing can stop them today—we will still get the retaliatory force off, that part of it that is on the alert. If that force is big enough and if it can penetrate, I think the aggressor will be strongly deterred."

"One of our weakest areas," Gen. Power said, "is the little information we have to work on. If there is anything that needs emphasis in this country, it is the ability to get more information about the Russians, and particularly their missile capability and their position in this missile race. One thing you can do in respect to this problem is to make sure that you support, and support vigorously, some of the new developments, particularly in space."

He also told the subcommittee that it is of paramount importance that "Mr. Khrushchev be made aware of our strength. What we think of ourselves does not really amount to anything so far as our deterrence is concerned. It is only what Mr. Khrushchev thinks of our capabilities that is important from a deterrence point of view. I am not advocating that we hide our weaknesses; but let us not hide our strengths if we are to impress this man."

No one, he added, except Khrushchev perhaps, knows that the minimum amount of deterrent required to prevent Russia from attacking the U. S.

Obsolete Equipment, Cutbacks Hobble TAC Reaction Capability

Washington—Obsolete equipment and cutbacks in new aircraft have placed Air Force's Tactical Air Command in a precarious position, TAC Commander Gen. O. P. Weyland, told the House Defense Appropriations Subcommittee in testimony released last week.

Further complicating TAC's problem, Gen. Weyland said, is the slow rate of phasing in new tactical fighter aircraft, reduction in funds for research and development of tactical weapon systems and the vulnerability of tactical forces to a missile attack, especially those located overseas.

Gen. Weyland told the committee that the bulk of the USAF reduction from the 137-wing concept to the planned 102 has been imposed on TAC. As a result, he said, at the end of the current fiscal year there will be a total of only 31 wings available to tactical air commanders. He termed this a "rockbottom" figure in view of its roles and responsibilities and the numerical superiority of the Soviet forces.

Gen. Weyland said that, with the present condition of his tanker fleet, he could not always guarantee getting a fighter-plane force to a trouble spot in the Middle East or Europe.

He termed the present tanker fleet as "hand-me-down" equipment, consisting of KB-50 bombers modified to tankers. The fighters, he said, have to descend to 15,000 ft. to refuel and then, to keep sufficient speed, coast down to about 12,000 ft. He added:

"There are a lot of conditions in deploying aircraft from the U. S. to Europe where we cannot top the weather, and it is most difficult to refuel a single-engine fighter when the poor fighter pilot is his own navigator, radio operator, pilot and everything else. He is as busy as a bird dog, and to try to refuel, communicate, navigate and hook up and refuel in the soup is asking quite a lot of him. However, we are training them for it, but it is a very marginal operation."

In answer to a question as to what percentage of the total inventory of planes assigned to TAC operations need modification and modernization, Gen. Weyland replied the entire tanker fleet.

"I would like to see jets, and I would put that at the top of my priority, even though it is not a combat airplane, to ensure the mobility of getting our tactical forces to the right place at the right time," he said.

Gen. Weyland said he now has six squadrons of tankers with 20 to a squadron. He added that, if these were replaced with KC-135 jet tankers, four tanker squadrons probably would be sufficient.

He said he also was concerned with the rate in which new aircraft were being phased in. The Lockheed F-104 and Republic F-105 are now coming in but in rather limited numbers, he said. He said there also is a question as to whether USAF has sufficient funds to pay for the number of F-105s currently programed.

"In the research and development area," he said, "we should very soon be developing the airplane on paper, and so on, which will replace the F-105. This should be what we call a vertical or short takeoff and landing airplane. We have very little money put in on that, not enough to assure that the airplanes will come along at the time I feel they will be needed."

Such an aircraft, Gen. Weyland explained, would eliminate a lot of the need for long concrete runways since they could operate from almost any site. It would also make deployment much easier and, at the same time, lower the enemy's attack capabilities because he would need far greater numbers of weapons to knock the forces out.

Another concern, Gen. Weyland said, is the problem of survival from a surprise attack. At the present time he felt the deployed overseas forces could receive enough warning to get off an acceptable number of aircraft to retaliate against the enemy.

"However, at such a time the Russians develop their missiles or other forces so they can catch us with less warning time then we are in dire straits."

Gen. Weyland told the subcommittee that "zero-length" launchers for fighter aircraft have been considered for Europe and that, while it has some advantages, it does not appear to be a good solution as a long-term proposition.

He said he also had proposed hardened "zero-launch" structures for protection of tactical fighters. He said he had requested the structures and that the theater commanders were in complete agreement that it was the most practical and economical solution. However, he said that to his knowledge no funds have been set aside for this.

Gen. Henry I. Hodes, U.S. Army commander in Europe, told the subcommittee that his major concern is keeping his present equipment in first-class condition and keeping an adequate number of supplies on hand. He also told the committee that:

- **He needs $60 million more** than that presently programed to maintain combat effectiveness.
- **Raytheon Hawk low-altitude** anti-aircraft missile is badly needed for the U.S. 7th Army. Hawk is presently programed for Europe.
- **Despite the fact that Russia** has decreased its personnel to a limited degree, it has improved its combat capability considerably, presumably through the introduction of new equipment.
- **In the interest of economy**, he was forced to cancel one practice alert and he probably would have to give up additional practice alerts.

Navy Requests for Aircraft, ASW, Missiles Trimmed in 1960 Budget

Washington—Fiscal 1960 budget requests from the separate Navy bureaus were trimmed by a total of almost $7 billion—from $17.9 billion to $11.46 billion—by Navy and Defense Department fiscal planners. Cuts included $72.6 million from requested research and development funds for anti-submarine warfare, a task given top priority last October by Chief of Naval Operations Adm. Arleigh Burke.

Over-all, Navy ASW officials in the Pentagon say they need an additional $1.2 billion during the fiscal year.

Navy's total budget was reduced to $13.9 billion within Adm. Burke's office before being sent to Defense Secretary Neil McElroy. When it was returned, the figure stood at $11.46 billion.

Adm. Burke told the House Subcommittee on Defense Appropriations that the Navy budget "ended up with our percentage, after everything was all through, the same as it was last year—a little bit less but roughly the same. That was, of course, a great disappointment to us. In this particular budget, I think we in the Navy have been unable to explain satisfactorily the really urgent need for new ships and new aircraft and missiles."

Another critical area cited by Adm. Burke was the "very low" funds available for operating Navy aircraft. Burke, who intimated Navy is now trying to get Budget Bureau approval for a supplemental budget request in this area, said accelerated flying schedules during the Formosan crisis last year cut deeply into Fiscal 1959 operational funds and that "what we have to do is to pull maintenance money over to keep opera-

tions going." Rear Adm. Charles E. Weakley, anti-submarine warfare readiness executive in Adm. Burke's office, later told the subcommittee that "we went after a figure in anti-submarine warfare research and development of $246,330,000. . . . The figure that is now in your budget is $174,692,000."

On the request of subcommittee chairman George Mahon (D.-Tex.), Weakley's office subsequently submitted an over-all breakdown of "additional needs" in the Fiscal 1960 program for ASW research, development and procurement funds. The breakdown, not to be construed as a request for "additional funds," included:

• **Research, development, test** and evaluation—$71,638,000. Funds would be used for development of a "simplified, modern anti-submarine weapon system suitable for backfitting older destroyers," ASW seaplane and helicopter development programs, acceleration of development of new anti-submarine torpedoes, hydrographic and oceanographic research, acceleration of development of nuclear-armed weapons, improved underwater communications and development of "various detection, classification and countermeasures equipments."

• **Aircraft and related procurement.** $141,432,000 for 91 ASW aircraft of various types and new sonobuoys.

• **Shipbuilding and conversion.** $151,638,000, including a hydrofoil submarine chaser, five attack submarines and an oceanographic research ship.

• **Major electronic procurement.** $26,112,000, including improved sonar equipment, identification systems.

• **Ordnance and ammunition** procurement—$151,638,000 for mines, torpedoes and a destroyer weapon launcher.

Discussing the threat of Soviet guided missile submarines, possibly nuclear powered, Adm. Weakley told the subcommittee that at present "there are not enough aircraft, not enough submarines not enough surface ships to cover the hunter-killer groups" and the convoys and ships the U. S. has at sea.

Among the rejected ASW budget requests, Adm. Weakley said, was a bid for research and development funds "to begin the preliminaries on a new seaplane for anti-submarine warfare." Present seaplane mainstay is the Martin P5M. Average age of these planes is 4.2 years which Weakley termed "pretty old for a first-line aircraft."

Other anti-submarine aircraft include the land-based Lockheed P2V-5 and -7 with an average age of 3.4 years, and the Grumman S2F with an average age of three years. Average age of anti-submarine aircraft carriers is 15.5 years; ASW submarines, 14.2 years.

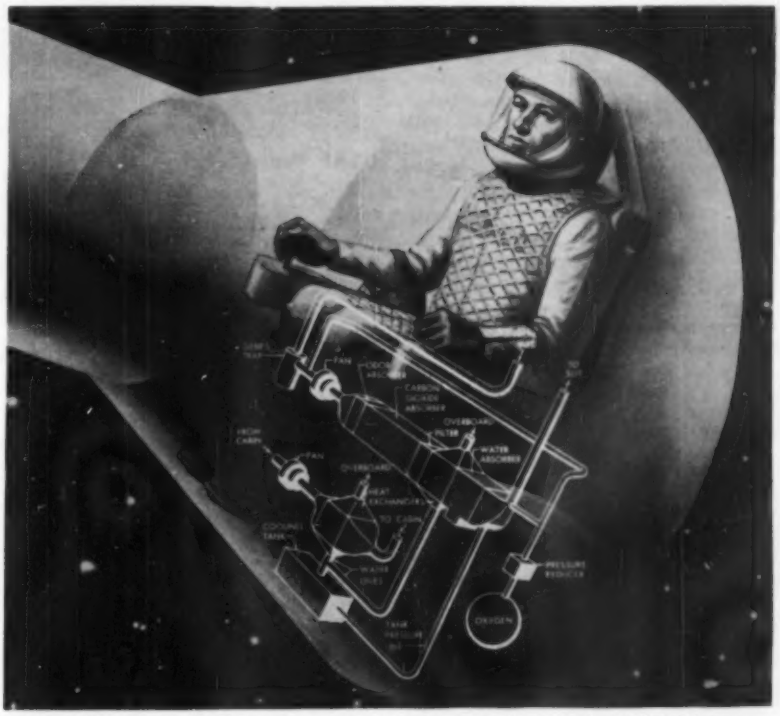
Adm. Weakley said, however, that the Navy has begun a three-to-four year modernization program to give present aircraft the necessary avionic equipment to detect future deep diving, quiet Soviet nuclear submarines.

In later subcommittee hearings, Adm. Jerauld Wright, commander of the Atlantic fleet, also urged that production and fleet availability of new anti-submarine aircraft "be expedited."

Terming naval aviation the "lifeblood of the modern active fleet," Adm. Wright said the Navy's active inventory is "rapidly decreasing" despite efforts to maintain its capability by overhaul, alteration and maintenance.

In discussing the vulnerability of surface ships to air-to-surface missiles such as the USAF-North American Hound Dog for the Boeing B-52G, Adm. Wright said, "we believe the Soviets have that kind of a weapon." The Soviet missile, however, is believed to have fairly limited range. Adm. Wright told the subcommittee:

"How good it is we don't know. We have certain methods of neutralizing that type of weapon. We think the best defense is to get at the airplane that has it, and if we can do that with our fighters, then we have the problem pretty well answered."



FLOW LINES oxygen will follow in a proposed environmental system for Project Mercury as outlined in this drawing. Carbon dioxide absorber is at foreground.

Mercury Oxygen Contract Awarded

Los Angeles—Environmental control system for National Aeronautics and Space Administrations' Project Mercury manned satellite will have a 28-hr. oxygen supply, which in addition to its respiratory function, will serve to pressurize and cool both the capsule and the pilot's suit.

Contract for development of the environmental system has been awarded to the AiResearch Manufacturing Division of the Garrett Corp. by McDonnell Aircraft Co., capsule prime contractor. AiResearch also supplies the environmental system for the North American X-15 research vehicle in which nitrogen rather than oxygen is used to pressurize and cool the pilot's suit.

At the 120-mi. orbit altitude, the system will maintain pressure equivalent to a 25,000 ft. altitude or about 11.1 in. of mercury (pressure at sea level is approximately 29.9 in. of Hg). Oxygen concentration at 120 mi. will be greater than that at sea level.

The Project Mercury environmental system will consist of two circuits and will work as follows: In one circuit, a fan will pull oxygen from the pilot's suit and through a debris trap. The fan will then push the air through an odor absorber, carbon dioxide absorber, filter, heat exchanger, water absorber and back into the pilot's suit.

In the other circuit, another fan will pull air from the cabin, send it through another heat exchanger and back into the cabin.

Air Force Asks Over $100 Million For ICBM Facility Construction

By Katherine Johnsen

Washington—Over one third of Air Force's proposed $343 million construction program for Fiscal 1960 is earmarked for operational facilities for intercontinental ballistic missiles, according to USAF witnesses at hearings of the House Armed Services Committee:

The funds will provide:

• **Balance of the operational** squadron sites under the current Convair Atlas program. Six operational sites already have been funded. The new sites will be constructed in a configuration which will provide an increased degree of dispersal and protection and capability for rapid retaliatory launching in the event of an attack.

• **Additional operational** squadron sites for the Martin Titan in fully hardened configuration.

• **Construction of test and prototype** launching facilities for the Minuteman solid-propellant intercontinental ballistic missile.

Army's Major Project

It was also disclosed that the major project in Army's coming year public works program is $67.5 million for research, development and test facilities for the Nike Zeus anti-missile missile program. Army has also programed $49.5 million for construction of Nike Hercules, Hawk and Missile Master control facilities in the United States and overseas.

Navy has programed $27.7 million for construction of the Pacific Missile Range facilities during Fiscal 1960. Total cost of the range is estimated at $250 million.

Navy estimates that it will require seven years to complete the range.

The total Fiscal 1960 military public works program of $1.3 billion, now pending approval by Congress, is divided as follows:

USAF, $873 million; Army, $231 million; Navy, $195 million.

USAF Projects

Projects in the USAF program include:

• **Satellites:** $33 million for launching sites, tracking and information acquisition sites, and control and data interpretation centers for satellite programs for attack warning, reconnaissance, communications and global weather surveillance.

• **Air-to-surface missiles:** $10 million for facilities for the North American Hound Dog and McDonnell Quail systems carried by strategic bombers to increase penetration capability. The funds will provide assembly, checkout and engine-test facilities at 15 B-52 bases inside the United States.

• **Bombers:** $18.2 million for conversion of four existing B-47 bases for B-52 intercontinental bombers at Homestead, Fla.; McCoy, Fla.; Larson, Wash., and Schilling, Kan. Construction already is completed or under way on 22 B-52 dispersal bases. These, with 11 bases formerly used by B-36s, will make a total of 37 B-52 dispersal bases. A total of $21.5 million is being requested to continue construction at Richard Bong AFB, Wisc., at which one of the first B-58 bomber wings will be deployed.

• **Strategic tankers:** $6.7 million for KC-97 facilities at six bases, and $1.6 million KC-135 facilities.

• **Defense missiles:** $27 million for construction of five additional Boeing Bomarc sites, which will bring the total of 14 Bomarc sites to 19.

• **Interceptors:** $25 million, primarily for shelters for the calibration of the interceptor weapons and shops for the maintenance of the extensive and sensitive armament and electronics equipment on the advanced types of Century-series aircraft.

• **Ballistic missile early warning:** $33.5 million; $189 million was provided last year to start the program. USAF said the program is now "well under way" and the $33 million is needed for additional facilities for the first operational sites.

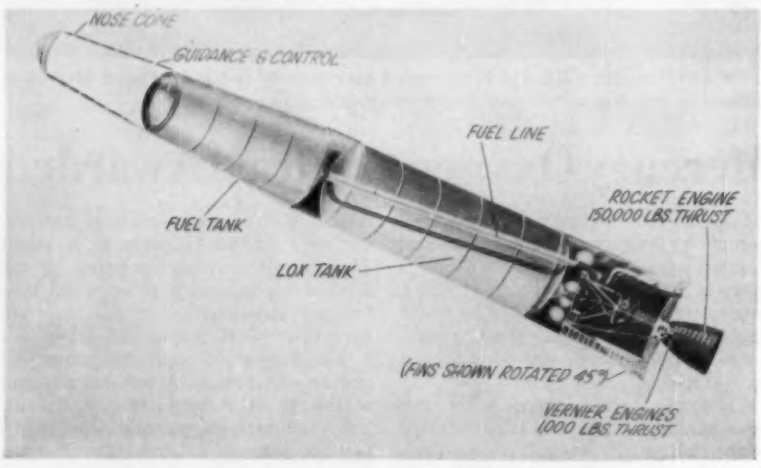
• **Aircraft control and warning:** $20 million. This is for increased electric power generating capacity at primary radar stations in North America required for the operation of new types of more powerful and longer-range radar equipment now being installed.

• **SAGE:** $76.3 million for the construction of a number of hardened facilities for the installation of solid-state computers in "supercombat" centers. USAF reported that these "supercombat" centers will substantially reduce the vulnerability of the SAGE system and will provide much greater capacities for air surveillance and weapons control.

• **Norad headquarters:** $10 million to initiate construction of a hardened combat operations center in the Colorado Springs, Colo., area from which North American Air Defense Command will direct and control the air defense of the United States and Canada.

• **Tactical force:** $10 million, for hardened facilities for the Mace missile at overseas locations.

• **Research, development** and test facilities: $23.7 million. The major projects are $5.7 million at Arnold Engineering Development Center, Tullahoma, Tenn., to provide increased capabilities for development work associated with supersonic aircraft and missile engine components under such conditions as orbital speed, and $7.3 million for a laboratory at Wright-Patterson AFB, Ohio, for research in sonic effects on flight vehicles.



Cutaway Shows Thor IRBM Detail

Artist's cutaway version of Douglas Thor intermediate range ballistic missile shows tankage configuration and general layout in the engine section. Note rotated fins at aft section and fuel line bypassing the liquid oxygen tank. Thor is 64 ft. 10 in. long and is 8 ft. in diameter. Thor engine has been combined with Bell Hustler rocket engine to put Project Discoverer satellite into orbit (AW Mar. 23, p. 19). Thor will go into operational service with USAF and British units.

NASA Selects Project Mercury Trainees

Washington—Seven volunteer military test pilots—three Air Force, three Navy and one from the Marine Corps—were named by the National Aeronautics and Space Administration last week to begin training as probable crew members in NASA's Project Mercury man-in-space program.

Under present planning, one of the seven is scheduled to become the first U. S. man in space within approximately two years. The seven will train at NASA's Langley Research Center, Va., under the auspices of the agency's Space Task Group headed by Robert R. Gilruth. They were selected from a list of 32 candidates after extensive physical, psychological and stress tolerance tests and evaluations at the Lovelace Clinic in Albuquerque, N. M.; USAF's Wright Air Development Center's Aeromedical Laboratories at Wright-Patterson AFB, Ohio, and NASA's Space Flight Activity at Langley.

Air Force officers selected after evaluation of the tests, which began at Lovelace Clinic on Feb. 7, are Capt. Leroy G. Cooper, Jr., 32, of the Flight Test Division at Edwards AFB, Calif.; Capt. Virgil I. Grissom, 33, test pilot at Wright-Patterson AFB, and Capt. Donald K. Slayton, 35, an experimental test pilot at Edwards since 1956.

Three Navy pilots are Lt. Malcolm S. Carpenter, 33, presently air intelligence officer aboard the carrier Hornet and former test pilot of the Grumman F11F F9F and Douglas A3D; Lt. Cmdr. Walter M. Schirra, 36, who has been conducting suitability development work on the McDonnell F4H all-weather fighter, and Lt. Cmdr. Alan B. Shepard, Jr., 35, former project test pilot on the Douglas F5D and now an instructor at the test pilot school at the Naval Air Test Center, Patuxent River, Md.

Marine officer picked for the program is Lt. Col. John H. Glenn, Jr., 37, now assigned to the Fighter Design Branch at the Navy Bureau of Aeronautics in Washington.

Anast Heads Lear In Management Shift

Top management shakeup in Lear, Inc. was announced last week by William P. Lear, board chairman. James L. Anast was named president succeeding Rochard Mock who moves up to vice-chairman of the board. Robert Hahn was named to the newly created post of executive vice-president.

In addition, two new group vice presidents were designated. Roy J. Benecci, former head of the Grand Rapids Division, will now be in charge of both this division and the Astrionics Division while Andrew J. Haiduck, former head of the Romec Division will direct both this division and the Electro-Mechanical Division.

Lear said the management changes were the result of a survey by an outside management analysis firm and were aimed at streamlining the corporation's management in the highly competitive avionics field. Lear said he would relinquish active direction of the corporation to the new management and serve only in an advisory capacity on special projects. A reshuffle of board of directors is in prospect.

News Digest

North American Aviation's acquisition of the Foster Wheeler Corp. is a major effort by North American to diversify into the commercial field in order to eliminate some of the peaks and valleys of defense contracting. North American is especially interested in obtaining Foster Wheeler's commercial sales organization, which North American does not have. Another factor is that North American has a nuclear reactor capability and Foster Wheeler builds the equipment for converting nuclear energy into power.

Lt. Gen. Clarence S. Irvine, deputy USAF chief of staff for materiel, will retire April 29 after 40 years of military service. He is expected to organize his own engineering and management consultant firm at Palm Springs, Calif.

First nose cone to be recovered after an intercontinental range flight was retrieved from the Atlantic Ocean last week after a Thor-Able fired from Cape Canaveral, Fla., carried an experimental Titan nose cone re-entry vehicle 4,400 naut. mi. Re-entry vehicle and essential instrumentation was made by General Electric, with Avco supplying the Avcoite reinforced ceramic ablative material for the nose cone. Recovery gear was supplied by Cook Electric Co. Thor has now been fired 38 times—26 times by itself, three times as a lunar probe booster, three times as a Thor-Able series I test vehicle and six times in the series II tests on ablating nose cones and ICBM guidance systems.

Hamilton Standard Division of United Aircraft Corp. has established an advanced product planning group to discover product possibilities in or out of the aircraft field.

New type of nuclear-thermoelectric generator, which directly converts heat from an atomic reactor into electricity, has been successfully demonstrated by Atomic Energy Commission's Los Alamos laboratory. Device, called a plasma thermocouple, uses uranium as one of the required two dissimilar metals and a cesium gas as the other. Present unit generates about 60 watts power with conversion efficiency of "a few per cent," making it a possible contender for use as secondary power source in satellites and space vehicles.

Sylvania will study methods of classifying and tracking ballistic missile warheads and decoys using special purpose computer devices under a contract awarded by USAF's Rome Air Development Center. Program will be carried out by Sylvania's Waltham (Mass.) Laboratories. Company is a major subcontractor to Radio Corp. of America for data processing portion of Ballistic Missile Early Warning System (BMEWS) program.

Liquid Hydrogen

Washington—Liquid hydrogen for use in the rocket development in the western U. S. will be purchased by the National Aeronautics and Space Administration from the Linde Co., a division of Union Carbide Corp. under a contract awarded last week. Contract calls for no guaranteed purchase amount.

Linde's plant at Torrance, Calif. will be expanded and the new facilities will be in operation within the next year.

Linde will pay for its plant expansion and has received a five-year contract to provide NASA with the high energy rocket fuel. Linde's bid for a sample year's supply of the fuel was $1.3 million, more than $1 million less than the next lowest bidder.

Projects which will make use of liquid hydrogen fuel include the Convair Centaur which consists of an Atlas first stage, a liquid hydrogen second stage and a new third stage. Centaur will be able to place 8,400 lb. in a 300 mi. orbit, send a 2,000 lb. payload into deep space or place 730 lb. on the moon. Centaur is presently being managed under Air Force contract by Convair, and the second stage engine is being developed by Pratt & Whitney. Project will be transferred to NASA at the beginning of the next fiscal year.

Project Rover, the nuclear rocket program under NASA-AEC cognizance, will require liquid hydrogen in some of its stages. The fuel will be shipped to the Nevada Test Site for Rover experiments by tank truck from Torrance.

AIR TRANSPORT

TWA's Gains Tied to Revised Schedules

Improved financial results in second half of 1958 attributed to analysis of schedules and cost studies.

By Glenn Garrison

New York—Adjustment of schedules has been the largest factor in Trans World Airlines' sharply improved operating results, TWA President Charles S. Thomas told AVIATION WEEK last week.

Even with the ill effects on traffic of a 17-day strike late in the year, the airline showed an operating profit of $10,196,000 for the last six months of 1958, compared with an operating loss of $1,305,000 for the same 1957 period.

Action taken under the new president's direction has included an intensive analysis of each segment of each schedule on TWA's routes, followed by a complete schedule revision. Along with the rescheduling there has been a cost study of every facet of the airline's operation, resulting in recommendations which eventually are expected to save TWA about $10 million a year.

Major Modifications

Also in process are major modifications of the company's organizational structure, with special emphasis on communications and the chain of command, and a new budgeting system.

Thomas told AVIATION WEEK that every one of TWA's flights had been cost-computed, and then each flight broken into segments and the cost of each segment computed. Utilization of equipment was then stepped up on the profitable runs and reduced on those that were losing money. Shifts in service also were made: in some cases, Thomas said, the studies showed too heavy concentration of coach service and adjustments in favor of first class service were made.

"In this business, scheduling, in my opinion, is your No. 1 thing," Thomas told AVIATION WEEK. The schedule revisions had "by far the greatest impact" on TWA's traffic situation, although other factors helped, including better business in general.

Thomas, after he assumed his duties as TWA president last July, set up five task force teams to study every area of TWA's expenditures. He picked young men within the company for this work, and broke their areas of concentration into sales, passenger service, operations, finance and general.

Recommendations from the task forces were put into effect and favorable results were particularly apparent in the last quarter of 1958, Thomas said.

Because of the strike, which made itself felt on traffic both before and after as well as during the actual period of shutdown, last quarter 1958 gross revenues were $61,680,000 compared to $64,136,000 during the last quarter of 1957, Thomas said. Nevertheless, because of the expense control program and schedule revisions, loss for the final 1958 quarter was $800,000 compared to a $9,650,000 loss for the final 1957 quarter.

The rescheduling also got primary credit from Thomas for improvement in load factors, which look significantly better this year compared with last. The early 1958 load factors on TWA's domestic routes were 60.7% in January, 57.7% in February, and 60.7% in March. This year, January domestic load factor was 71.2%, February 60.6%, and March 63.7%. International load factors also were up slightly in February over that month of 1958 and the March, 1959 international load factor of 59.2% compares with a March, 1958 figure of 56.2%.

Thomas cited several specific examples of savings indicated by the task forces' recommendations:

• **"Through" fueling,** or taking on fuel at only one stop instead of several over a route with multiple segements. The single fuel stop is made at the station where fuel costs are lowest.

• **Optimum aircraft cruise powers** determined by an intensive study. Adherence to these standards is expected to save $750,000 annually.

• **Reorganization** of overseas controllers' departments, involving among other things a reduction in area controllers. Expected to save $275,000.

• **Adoption** of Federal Aviation Agency-approved airport familiarization films for pilot qualification to reduce flight training. Expected saving $120,000.

• **Consolidation** of the reservations control function, formerly split between New York and Kansas City, at New York. Expected saving $46,000.

• **Elimination** of the pneumatic tube message system at Idlewild. Expected saving $70,000.

Flexible Budget

The new budget system, Thomas said, will be a major expense control tool. The old quarterly budget system, he said, "has not been geared to present operations." Under the new plan, the budget will be annual and flexible. It will be set up at the first of the year. At the same time, operations standards in all areas will be established.

If revenues increase sufficiently and performance to standards warrants it, the budget can be expanded to provide for more personnel. On the other hand, cuts can be made when the opposite conditions appear.

Generally, the tight expense control plans mean consolidations, elimination of overlapping and cutting out "refinements and luxuries you don't need," Thomas said. But this will not involve a "wholesale reduction in people," he added.

Airline Improvements

The new chief executive hopes to effect major improvements in communication between the field and top management and particularly to delegate more day-to-day authority. There are now 13 different persons reporting directly to the president, making that official "the day-to-day operator of the company," according to Thomas. This leaves the president with insufficient time for the necessary planning and long-range thinking which his duties require.

TWA's basic route system is excellent, Thomas said, and should pay off with proper scheduling, utilization and expense control. Utilization will become more of a problem in his view

TWA Jet Deliveries

New York—Trans World Airlines' previously unannounced jet delivery schedules, as outlined to Aviation Week by TWA President Charles S. Thomas, call for receipt of all of the carrier's 15 Boeing 707-120s by July.

Delivery of the long-range Boeing 707-320s will begin in November, Thomas said. Hughes Tool Co. has ordered 18 of these aircraft. Final jet equipment under present plans, the Convair 880, will start arriving in early 1960, according to Thomas. Hughes has ordered 30 of the 880s.

EXPANSION of Trans World Airlines' jet services will follow delivery of additional Boeing 707-120s. Four airplanes destined for TWA are shown above at Boeing's Renton, Wash., plant being readied for first flight. Other jets on the ramp are 120s for American Airlines and Qantas, the Australian airline. TWA jet service between Chicago and Los Angeles was scheduled to start last week, and New York-Los Angeles service is planned by July. Airline inaugurated its first jet service Mar. 20 with New York-San Francisco nonstops.

as piston aircraft are phased out and jets replace them.

By the time the Convair 880s arrive in 1960, TWA's piston equipment should be fairly well phased out, Thomas said.

TWA inaugurated its first jet service on Mar. 20, a daily transcontinental nonstop between New York and San Francisco.

Chicago-Los Angeles jet service between the two cities was scheduled to begin last week.

New York-Los Angeles service will follow later this month, Thomas said, and additional cities will receive TWA jet service by July. During that month, Thomas said, the airline will be operating six daily jet schedules with 660 seats out of San Francisco to major U. S. cities.

Operating Loss

While TWA's fortunes showed a marked upswing during the last half of 1958, its net over-all loss for the year was $1,764,000, some $206,000 greater than the net 1957 loss. This was attributed chiefly to lesser gains on the sale of equipment, lower tax credits and other nonrecurring items. Operating loss for the full year 1958 was $375,000, compared with operating losses of $4,539,000 for 1957 and $4,131,000 for 1956.

Had there been no strike in 1958, Thomas believes, the company would have shown an over-all net profit for the year. As it was, TWA showed the highest second-half-of-the-year operating profit since 1954.

Discussing the results since he took office, Thomas told AVIATION WEEK "I'm not trying to kid myself at all, but I think we're on the right track now." There is "nothing wrong with the people in TWA," he said, and the route system offers an excellent potential.

"Given the proper organization and leadership, there is nothing in the world to prevent TWA from being one of the most profitable airlines in the business," Thomas said.

American Protests Supplemental Ruling

Washington—American Airlines has taken legal action to reverse a Civil Aeronautics Board ruling granting permanent operating authority to 23 previously non-certificated air carriers.

Attorneys for the airline, protesting the Board's actions in the Large Irregular Air Carrier Investigation, have filed for a review of the decision in the U. S. Court of Appeals for the District of Columbia.

Granting of the certificates will allow the supplemental carriers to compete directly with American. As few as three of the newly certificated carriers could provide a daily schedule between any or all of American's points by utilizing their 10 trip a month authorities between any two points in the United States, according to American.

American added that Board approval of unlimited charter service to air freight forwarders also could lead to the establishment of an unlimited number of competitive freight-carrying airlines duplicating the existing freight services of American.

In a 17 point objection to the CAB order, American termed the Board's action "arbitrary and capricious" and said that it:

- **Failed to specify the terminal** and intermediate points for the supplementals in violation of Section 401(e) of the Federal Aviation Act.
- **Established a definite** flight limitation for the supplementals in violation of Section 401(e).
- **Exceeded the proper scope** of the Large Irregular Case in granting individually ticketed and waybilled service because such air transportation is neither additional nor supplemental, but duplicates existing certificated services.
- **Took no action to monitor** the transfer of control between supplementals even though their qualifications are based upon the qualifications of existing management.
- **Failed to provide** for termination of unused operating authority, contrary to the public interest, and thus encouraging trafficking in supplemental air carrier certificates.

Qantas Loses U.S. Domestic Route Bid

Washington—Qantas Empire Airways last week lost its bid to compete in U. S. domestic air travel markets on the transcontinental segment of its around-the-world route.

In a unanimous decision on a petition filed by the Australian carrier to transport international traffic between two U. S. points, the Civil Aeronautics Board found that foreign airlines may carry only that traffic within the U. S. which it either brings into or will take out of the U. S. The decision was issued as an opinion and interpretative ruling following the institution of a rulemaking proceeding.

The ruling is expected to thwart any future moves by foreign flag carriers to seek authority to operate within U. S. domestic markets and establishes the right of cabotage by U. S. operators. Cabotage is the principle that each nation may reserve the transportation of all types of traffic within its own territory for its own nationals. There are 15 foreign airlines authorized to serve two or more points in the U. S.

Essentially, Qantas sought from the Board an interpretative ruling that would permit it to carry international traffic between San Francisco and New York regardless of how that traffic entered or departed the U. S. (AW May 19, p. 38).

The Qantas bid had the backing of British Overseas Airways Corp. which is awaiting a Board decision on a request to include Tokyo on the transpacific leg of its around-the-world route. The airline "temporarily postponed" the transpacific service last week, charging Northwest Airlines with a delaying action that forced it to stop the service two days after it was inaugurated April 1 (AW April 6, p. 40). Here is a summary of findings by the CAB in the Qantas case which began early last year:

- **Restriction in the Federal Aviation** Act that no foreign civil aircraft "shall take on at any point in the U. S., persons, property or mail carried for compensation or hire and destined for another point in the U. S." applies to foreign civil aircraft operating under a foreign air carrier permit issued by the board.
- **Restriction applies to all** traffic including traffic that will continue to move to a foreign point by another air carrier or other means of transportation.
- **Term "foreign air transportation"** as it appears in foreign air carrier permits does not permit a foreign air carrier to move traffic between two U. S. points.

Decision against Qantas by the Board is expected to increase the friction that has been developing for the past six months between the U. S. and the British Commonwealth in air transportation matters. These differences have been sharply intensified by the violent opposition Northwest has taken against the BOAC bid to start transpacific service between Hong Kong and New York via San Francisco and Tokyo.

Air Service Agreement

BOAC Managing Director Basil Smallpeice said last week in Tokyo that his carrier has the right to operate the Tokyo service under the Air Services Agreement between the U. S. and U. K. He said the company was forced to delay the service because of the need of a CAB foreign air carrier permit and added:

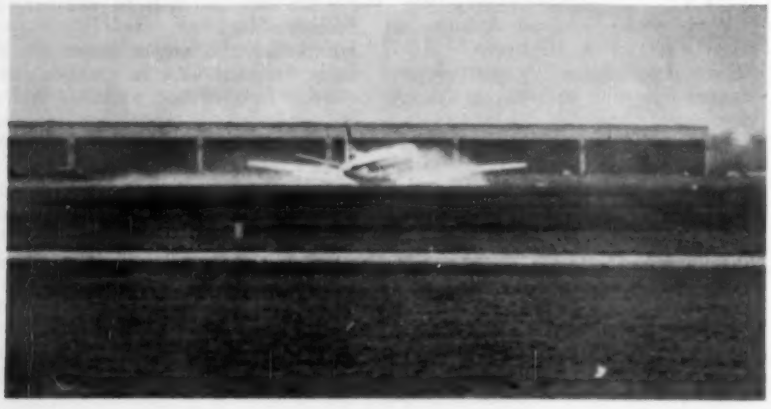
"Under British procedure, and under the same agreement, an American operator obtains an operating permit virtually automatically from the U. K. government." He noted that the application for the Tokyo route had reached the CAB on Nov. 4 and added:

"Today, some five months later, we still have not received any permit despite the stipulation in the agreement that permission to operate shall be granted without undue delay. By any standard, five months is more than undue delay."

In its arguments against the BOAC petition for the Tokyo stop, Northwest has contended that BOAC would have an "extraordinarily competitive position" in the U. S.-Japan market. It noted that the three U. S. points—New York, San Francisco and Honolulu—sought by BOAC accounted for 53% of all U. S.-Tokyo traffic carried by Northwest and Pan American in the year 1957.

Capital Viscount Makes Successful Belly Landing

Capital Airlines Viscount turboprop transport, its landing gear jammed in the up position, made a successful belly landing at Detroit's Willow Run Airport. Aircraft circled the field for about three hours before making its approach to the foam-covered runway (top). Viscount made a smooth belly landing (bottom) and 11 persons aboard all escaped injury. Aircraft was on the New York-Detroit run. For details of Viscount accident in Great Britain, see p. 149.



In its decision in the Qantas case, the Board made reference to traffic diversion by stating that the volume of transfer traffic involved in the Qantas decision is "substantial and represents an important part of what is generally regarded as the domestic market. Thus, on the basis of 1957 survey data, the over-all value to all U. S. carriers of 'transfer traffic' of the type here involved was in excess of $30,000,000."

On the subject of competition, Smallpeice noted that Northwest would not compete with BOAC through Honolulu and San Francisco since Northwest does not serve this route and added:

"Nevertheless, Northwest complains of potential competition from BOAC's new service" and its failure to win rights for a new route beyond Tokyo to Hong Kong.

BOAC Aims

He added that "it should be made clear that what we in BOAC are seeking to do is merely to exercise our right under the agreement to provide British counterpart to the American services across the mid-Pacific. These have been operated by Pan American Airways since 1946, linking Hong Kong with San Francisco. On this route, Pan American already is also operating services over the sector between Hong Kong and Tokyo and actually carries more traffic than any other operator between these two points, one British and the other Japanese."

He concluded by stating that it would be "quite unreasonable" to grant another American carrier, Northwest Airlines, a new route into Hong Kong.

Carriers Ask Probe Of National Fare Plan

Washington—National Airline's proposed 25% reduction in night coach fares to Miami is drawing heavy fire from competing carriers forced to file similar tariffs as a protective measure.

Northwest, Northeast, Eastern and Delta countered the proposal by filing competing tariffs but last week told the Board they will withdraw their own filings if the CAB approves their request for suspension and investigation of the National fare plans.

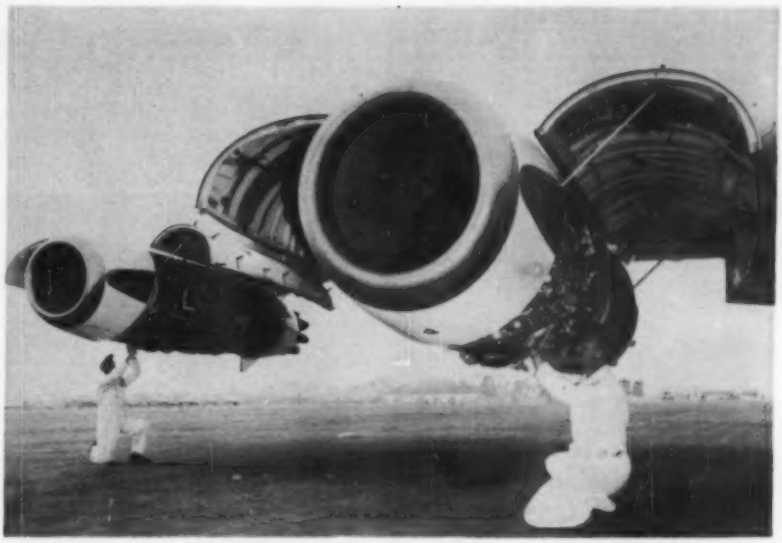
The objecting airlines contend that the intense competition that would follow National's reduced fare plan for Monday, Tuesday and Wednesday nights would adversely affect the revenue passenger mile yield to the point where such efforts to attract a "mass market" would be economically impractical.

Eastern contends that National will be unable to cover the cost of the reduced fare based upon an expected yield of 3.2 cents per revenue passenger mile as compared to National's present yield of 4.28 cents for night coach service. Utilizing this yield as a yardstick, Eastern estimates that National's break even load factor would have to approximate 128% on the Convair-340 and 96% on the DC-6 and DC-7.

Eastern said that present night coach fare between New York and Miami is $46.80 as compared with $44.86 by rail and $35.35 by bus but that even National's proposed $35.10 fare will have little effect upon persons who drive their cars to Florida. It added that CAB approval of the reduction would be little more than a "giveaway" which would cause all airlines to suffer financial losses.

Northwest, which filed for a 25 % reduction in night coach fares between Chicago and Miami as a protective measure only, told the Board that such a plan will not attract new passengers but will divert existing traffic since the fare cut will represent about half the cost of existing first class fares. Northwest pointed out that many uncertainties on fare questions will be settled in the expected decision in the General Passenger Fare Case.

Northeast filed its reduced tariffs out of Boston, New York and Washington and told the CAB the reduction will not stimulate its Florida bound traffic enough to offset an expected diversion from its first class service to Miami.



Convair 880 Pods Designed for Accessibility

Maximum accessibility has been designed into the Convair 880 jet transport pods for inspection and repair of General Electric CJ-805-3 turbojet engines. Engines shown here are equipped with General Electric daisy ejector type sound suppressor. Pod features only three main engine mounts—stabilizing mount at forward top of engine, and two main engine clamp type mounts on horizontal center line in the plane of the engine turbine case. Upper portion of pod is skinned with titanium to serve as a firewall; titanium also is used in pod leading edge and compressor nose cone to withstand high temperatures needed for thermal anti-icing.

Tokyo International Readies Expansion

Tokyo—Tokyo International Airport Authority has settled two-year-long negotiations with 16 local fishermen's associations for settlement of claims against expansion of airport facilities. The authority will pay the fishermen $1.5 million for the damage of adjacent seaweed farms in Tokyo Bay.

The settlement permits Haneda Airport authorities to proceed with a program for jet accommodation at the field. The authority will start the five-year $15.3 million project later this month.

The airport will take in 3,184,500 sq. ft. of land by filling in Tokyo Bay, increasing the total area 30% to 11,088,000 sq. ft. The present 8,415 ft. long and 148.5 ft wide Runway A will be extended 297 ft. to the north and 198 ft. to the south by September to permit temporary jet service.

Runway A will be used, with the installation of an instrument landing system, for jet passenger planes until the fall of 1963. By that time, the airfield will be large enough to extend the runway to 10,000 ft.

In parallel with the old runway, a new 10,395 ft. runway will be built. When the project is completed, a port authority spokesman said, planes can either land or take off every two or three minutes, instead of the present schedule of every seven or eight minutes.

"Airline pilots prefer concrete runways because only concrete provides the added safety factors"

Says **CAPT. R. A. STONE,** *veteran airline pilot*

"On take-offs, a level concrete pavement eliminates the disturbed airflow over the wings so frequently caused by a wavy, flexible pavement pitching the airplane nose-up and nose-down. Also, there's no dragging action on the wheels such as flexible pavement has when it softens. On concrete you accelerate to safe flying speed fast and without a lot of bumps and jolts. Furthermore, concrete means cooler temperatures on the runway which in turn mean greater lifting power from the wings and greater horsepower from the engines.

"For landing at night or in fog, we still have to see the runway, even with all our modern electronic aids. Concrete is much more visible under these conditions because it reflects light instead of absorbing it; the concrete runway stands out instead of blending in with the dark background.

"Better braking is important, especially in wet weather when you're trying to stop 50 tons of airliner that touches down at 125 miles an hour. (The new jets are even heavier and faster.) Tires can always take a good, firm grip on skid-resistant concrete.

"While everybody wants this kind of safety, some people think concrete is too expensive. However, all the figures we've seen show concrete actually saves real money for airports. The airline pilots recommend spending what it takes to get safety now and simultaneously gain the practical, money-saving advantages of concrete throughout the years ahead."

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FAA Adopts Mobile Lounge Plan

By Robert H. Cook

Washington—Federal Aviation Agency last week adopted a new concept of passenger handling between terminal and aircraft that could lead to major design changes for all planned jet airports.

Growing use of "finger" facilities now being used at most major terminals, and planned for jet airports could virtually be eliminated in favor of a fleet of specially designed "mobile lounges" selected for use at the Washington International Airport, now under construction at Chantilly, Va.

Reviewing construction progress on the new 9,600-acre jet airport, James T. Pyle, deputy administrator of the FAA, said that installation of the mobile lounge service may result in a revamping of designs now being considered for other jet airports once its expected advantages are proven at Washington International.

The airport is scheduled to begin operation by early 1961.

Pyle said all existing architectural designs for jet terminals were considered in light of expected traffic growths at the airport to reach 8.7 million passengers by 1975 and the ultimate need for aircraft apron space capable of holding 90 large aircraft at one time.

Selection of the mobile lounge design, with a 20-unit fleet serving 30 gates by 1965 is expected to provide the following advantages:

- **Permit a construction saving** of $3 million in the terminal building as opposed to "finger-gangplank" type of loading design.
- **Eliminate any long walking** distance between central terminal building and loading gates which could otherwise stretch nearly a mile in the case of large jet terminals.
- **Allow a wide dispersal** of maintenance and operations facilities and parking aprons.
- **Permit increased maneuverability** of landing jets which may taxi directly from highspeed turnoffs to amply separated parking aprons.
- **Eliminate the need** for any towing equipment or other devices to protect passengers and terminal building from jet noise and blast effect.
- **Allow future terminal expansion** with a minimum of design change and cost.

As envisioned by FAA architects and planners, the mobile lounge would, in effect, constitute a powered waiting lounge designed to connect directly to the terminal building or the aircraft. FAA has talked with more than 25 manufacturers, one of which will be selected in the near future to build the first operational prototype at an expected cost of $100,000. If widely adopted, manufacturers estimate the lounges will sell for about $60,000.

A refined version of the European bus-to-plane type ground service, the vehicle would stand on cushioned stilts and wheels. Measuring about 15-by-60 ft., it would accommodate about 80 passengers at a second-story level and could be driven from either end, eliminating the need to turn around.

Passengers at Washington International will walk a short distance from the ticket counters to one of a series of in-line departure gates which connect directly with a mobile lounge. Minutes before flight time, lounge doors to the terminal will close and the conveyance will move to the aircraft where the forward end of the vehicle equipped with pneumatic units will press against the aircraft fuselage to form a sealed unit. The lounge operator may then adjust the unit for any difference in doorway height and unload the passengers.

For incoming aircraft, the lounge would be dispatched just prior to aircraft touchdown and would be waiting within 200 ft. of the assigned parking apron, FAA planners said. For unusually large jet aircraft, mobile units probably will be dispatched in pairs. Units would be air conditioned and carry two-way radio communications for direct contact with tower controller.

Utilizing the lounge concept, FAA architects plan a rectangular terminal building about 1,000 ft. long with 30 gate positions, which later will be expanded to 100 positions. Although planned primarily as a jet terminal, the building will provide a few short finger corridors to serve such smaller aircraft as the Douglas DC-3, Martin 202 and Convair 340 series.

Initially, the agency estimates a capital expenditure of $3,785,000 for the mobile lounge design building, compared to $6,865,000 needed for a finger-gangplank type of building. At today's construction costs, FAA officials point out that it costs about $75,000 for each 3,265 sq. ft. gate space under the finger design as compared to only $20,000 for each mobile lounge space of 800 sq. ft., thus affording better utilization of valuable terminal space at a much lower initial cost.

Total annual cost of operating the lounge system, including maintenance and based on projected 1965 figures for the new jet terminal, will approxima.. $883,000 as compared to $1,065,000 for the finger system, said FAA.

FAA spokesmen said that, while the mobile units have been selected as the solution for Washington International, the concept is expected to be of equal value for either terminals now being designed for jet traffic or major airports, such as Midway in Chicago, where room for further finger expansion is nonexistent. In addition, architects point out that it could well answer the needs of terminals which may receive only one or two jet flights daily by avoiding the need for expensive structural changes to existing buildings.

FAA said it will award one contract for both the design and manufacture of a mobile lounge prototype for completion by January 1, 1960, after which the vehicle will be tested for a three month period and then manufactured in quantity.

Construction on the new jet airport began last September with clearing operations. Three major contracts, totaling $18.8 million have been awarded out of the $62.6 million available for the project to date. Buildings are expected to start rising by the middle of this year with runways scheduled for completion by July, 1960, and the first operational flights by Jan. 1, 1961.

House Unit Challenges FAA Report Policy

Washington—House Government Information Subcommittee is challenging Federal Aviation Agency's policy of keeping airline reports on the malfunctioning of equipment secret.

Issue was touched off by the crash of a Lockheed Electra at LaGuardia Airport on Feb. 3. FAA's refusal to make public release of information on possibile difficulties encountered with the new type altimeter installed in Electra and Boeing 707 aircraft attracted the subcommittee's attention.

In a letter to Rep. John Moss (D.-Calif.), subcommittee chairman, FAA Administrator Elwood Quesada disclosed that only two altimeter malfunctions were voluntarily reported prior to Feb. 3. As a result of a survey by FAA, 20 reports of altimeter malfunctioning were subsequently received, Quesada said. Quesada noted that the Lockheed Electra turboprop and Boeing 707 turbojet transports have three to four altimeters installed in the cockpit. "To our knowledge, there has never been a malfunction of more than one altimeter on any one flight," he said.

Quesada said FAA considers reports of malfunctions of new types of aircraft "to be company property submitted to the FAA on a voluntary and, to some extent, confidential basis. Further, there is good reason to believe that, should we make these reports generally available to the public, we might tend to reduce the high degree of valuable industry cooperation we now experience in receiving complete information on malfunctioning which is vital to continued safe operations."

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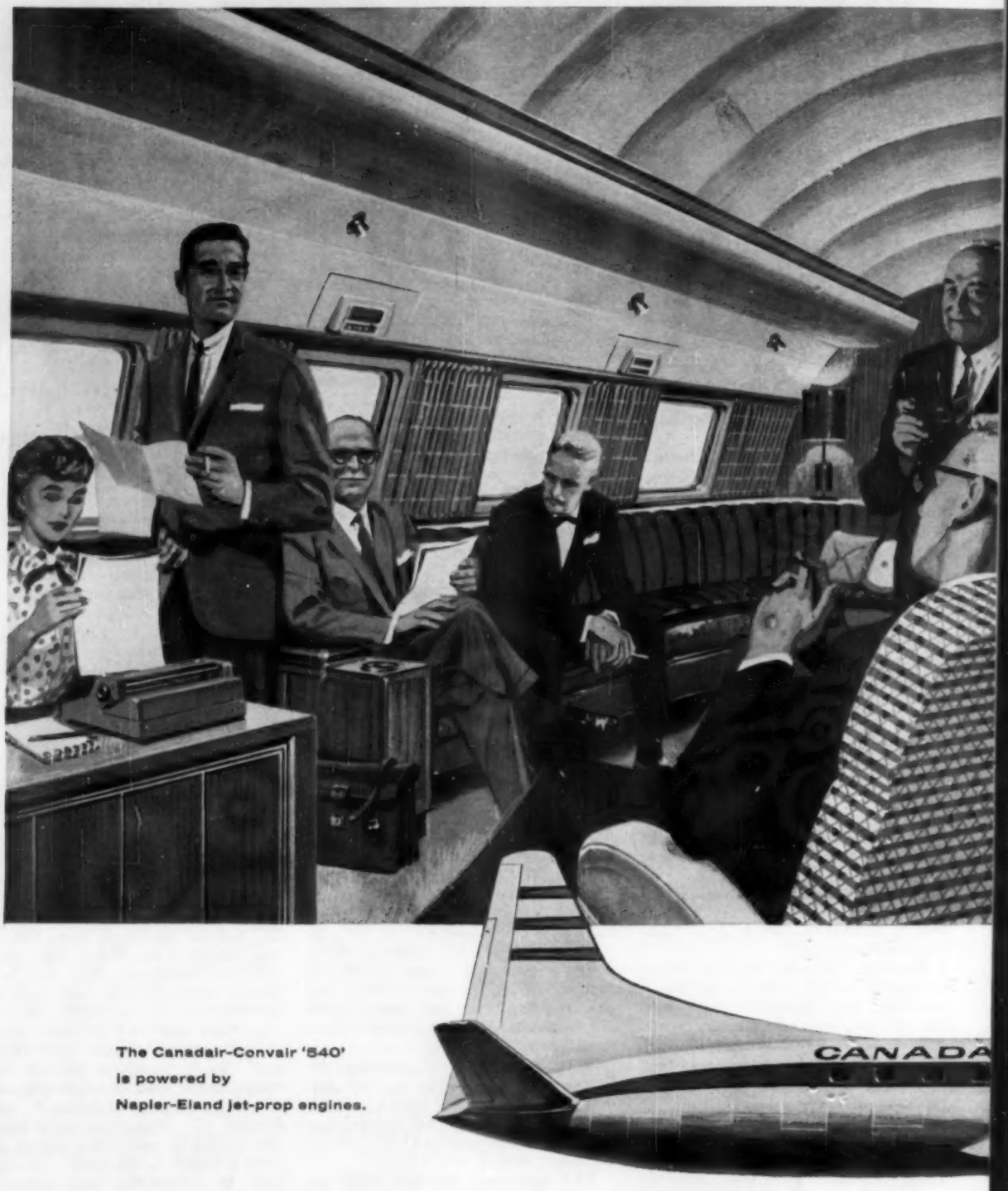

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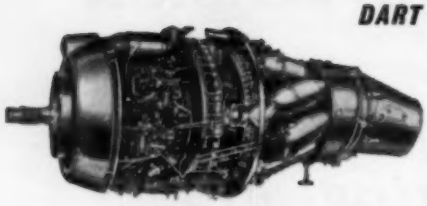

In service or under development at powers ranging from 1,540 e.h.p. to 3,200 h.p. The Dart is the most proven prop-jet in the world and has flown over 7,000,000 hours in scheduled airline service. It has an unexcelled record of reliability and is currently operating at overhaul lives of up to 2,300 hours.

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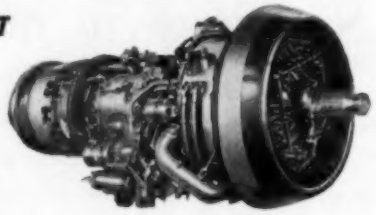
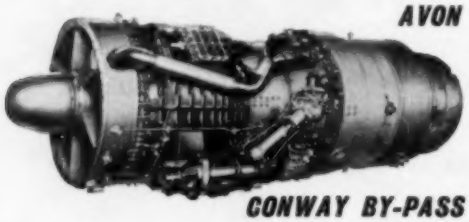


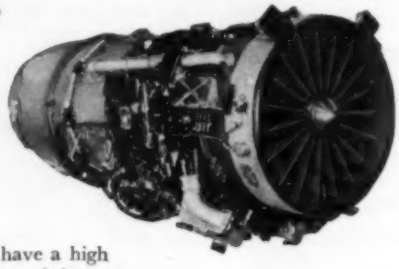
AVON TURBO JET



The Civil Avon has been developed to give low fuel consumption and long life between overhauls. The British Air Registration Board authorised its entry into service at an overhaul life of 1,000 hours.

CONWAY BY-PASS TURBO JET

The Civil Conway has the advantages of low first cost and operating costs, low weight, less noise and low specific fuel consumption. Initial Civil Conways have a guaranteed minimum thrust of 16,500 lb. and engines of 17,500 lb. and 18,500 lb. guaranteed minimum thrust, will be available.



RB. 141 BY-PASS TURBO JET

A new by-pass engine of advanced design, the RB. 141 will have a high by-pass ratio, and a specific fuel consumption and noise level much lower than any existing comparable engine.

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SHORTLINES

▶ **American Airlines** flew 431 million revenue passenger miles during March, an 8.8% increase over March, 1958. American's air freight traffic rose 13.4% to 8,400,000 ton-miles.

▶ **Bonanza Air Lines** flew 18,429 passengers during March, the airline's highest monthly enplanement figure. Bonanza attributes some of the new passengers to its Fairchild F-27 flights which carried 1,337 passengers during the first five days of service.

▶ **British West Indian Airways** will begin new 30-day excursion fares at reduced summer rates from New York and Miami to Barbados, Trinidad and Tobago, with intermediate stops, on May 1. The 30-day fare from New York will be $289 to Trinidad and $203.50 from Miami to Trinidad.

▶ **Federal Aviation Agency** has released its newly revised "Small Airports" booklet compiled to aid persons who want to establish a small community airport. Booklet can be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

▶ **International Air Transport Assn.** is circulating a questionnaire to its member airlines to determine their present practices in provisioning and scheduling of aircraft, engine maintenance, overhaul, modification and repair with an eye to the problems arising in the jet era in this field. Questionnaire arises from studies being undertaken by a special Production Planning and Control Group of the IATA Technical Committee to work out better methods of procuring and planning due to the growing investments for spare parts for jet aircraft, which can exceed more than $1 million for one airliner. Increased efficiency and economy is the goal of the study.

▶ **Mexico City's International Airport** is expanding to meet requirements of jet transports by lengthening the main runway to about two and one-half miles fully paved and installing a new high intensity lighting system. The Mexican government project also includes widening and lengthening of principal runways, 24-hr. radar installation and an auxiliary field for private aircraft.

▶ **United Air Lines** reports year-end net earnings of $14,300,262, equivalent to $4.05 per share on 3,530,608 shares outstanding. Operating revenues totaled $316,816,712 over operating expenses of $286,262,924, including $28,847,941 in depreciation charges.

AIRLINE OBSERVER

▶ **American Airlines' pilot training program for the Boeing 707-123 is running behind schedule and is proving more costly than anticipated because of failure of many senior pilots to make the grade with the turbojet equipment. In one recent class of 16 line pilots, four were washed out, four were marginal and went through the course a second time and four quit of their own accord before completing the course, giving them a chance to try again. The balance of four pilots completed the training and are now flying the Boeing in scheduled operation.**

▶ Early reports from trunkline carriers indicate that the industry will report its highest first quarter revenues in history. Bright outlook for the year has been reflected in activity of airline stocks listed in the New York Stock Exchange where most listings continue to register strong gains. Leading airline stocks which continue to record new highs for the year are American, Eastern, Northwest and Pan American.

▶ **Mohawk Airlines reports a 10-15% improvement in block time with the Canadair 540 turboprop over actual operation of its Convair 240 on a five-stop round trip evaluation flight between Utica and Detroit (AW April 6, p. 38). Airline reported that the 540 climb-out averaged more than 1,500 fpm., true cruise air speeds ranged up to 318 mph. and averaged 300 mph. Canadair performance indicated that it would operate terminal-to-terminal with 58-passenger payload without refueling compared with the three times required for refueling on the Convair 240 on the same flight with 46 passengers.**

▶ Russia's Aeroflot state-owned airline is evaluating the twin-engine Czechoslovakian five-passenger "Morava" L-200 light transport for use in feederline and air taxi service. The "Morava," which has a cruising speed of 161 mph. and a range of 994 mi., is faster and slightly longer-ranged than the twin-engine Czech Super Aero-45s, which Aeroflot began purchasing "in quantity" last year for short-haul operations.

▶ **Aeroflot carried 56% more passengers in 1958 than in 1957, according to the USSR's Central Statistical Administration. The Soviet airline exceeded its passenger traffic goal for the year by 17% and "overfulfilled" its total ton-mile goal by 3%.**

▶ Allison has begun work on the first production conversion of a Convair 340 to Allison 501-D13 turboprop engines and is scheduling Federal Aviation Agency certification for October. Conversion is being handled by PacAero Engineering Corp. under a subcontract arrangement in which Allison negotiates direct sales with customers.

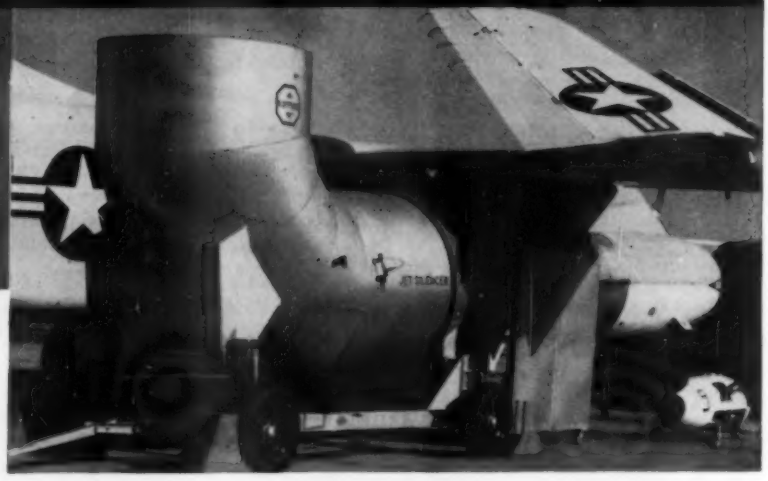
▶ **Chances are strong that reconfirmation rule may be dropped this year when two remaining features of no-show plan—minimum time limit for ticket pickup and reconfirmation—come up for review by the Air Traffic Conference. Majority of airlines are actively seeking ways of simplifying ground-handling of passengers and many now consider elimination of the reconfirmation rule as one way of cutting down volume of incoming calls that create bottlenecks in reservation departments.**

▶ Ansett/ANA Airways of Australia's request for a third Lockheed Electra turboprop transport has been turned down by the Australian government. The government, however, has indicated its willingness to authorize the purchase of additional Vickers Viscount 800s. Carrier is expected to renew its pressure for more Electras and, if successful, will prompt Trans Australia Airlines to make a similar request.

▶ **Aerolineas Argentinas will begin Comet 4 turbojet service to Europe May 19 and to the United States May 29. Beginning April 10, the airline will operate Comet flights between Buenos Aires and Santiago.**

▶ Allegheny Airlines anticipated a 30% decline in Detroit traffic during initial period of operations at Metropolitan Airport following the move from Detroit's Willow Run Airport. However, during the first 30 days of operation at Metropolitan, the carrier experienced a 10% increase in traffic.

Run up
the Jet-



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Airlines Predict Traffic Growth in 1959

By L. L. Doty

Washington—Optimistic outlook for a new period of traffic expansion during 1959 as more jet equipment is introduced highlights the annual reports now being distributed by trunkline carriers.

In nine annual reports issued thus far, trunkline carriers generally indicate that they expect a revival of the historic growth pattern that came to a halt last year after a decade of consistent yearly expansion. In addition, the reports reassure stockholders that the majority of the jet re-equipment programs will materialize as originally planned.

Of the 12 trunkline carriers, nine have issued their annual reports. Delta and National report on a fiscal year ending June 30. As of late last week, Northeast had not yet mailed its report to stockholders.

Fare Hikes

Need for fare hikes was again stressed in the reports, although some carriers are placing less emphasis on the issue this year than last. TWA, for example, made no new demands for a fare increase but noted that an 11% increase in international traffic could be attributed "largely" to the introduction of the economy fare service.

Northwest, which urged a fare increase of up to 13% in its 1957 report, made only a three-line mention of fares in last year's report. Braniff, Capital, Continental and United put particular emphasis on the urgent need for fare increases in their reports as did Delta in its quarterly report for the period ending Dec. 31.

Five carriers were outspokenly optimistic over potential growth throughout the year. Northwest based its optimism on its new Florida route and the scheduled introduction of Lockheed Electras later this year.

American noted that "if good business conditions continue, there should be excellent opportunity for profit." Braniff forecast a "profitable" year and based its confidence in "new and increased traffic" on the introduction of turbine equipment. Western said it anticipated 1959 will "be the best in the long history of Western" because of an economic "resilience which seems unparalleled in the tradition of American industry."

Eastern made no direct forecasts for 1959 but indicated a strong confidence in a continued expansion of its operation. Capital also made no reference to future growth other than to stress that "continued increase in airline seating capacity makes it mandatory that the traffic base be broadened by the development of new business."

United also avoided any bright predictions for 1959 and warned that "competition in 1959 will be intensified because of early inauguration of jet service by several competitors." It added:

"The management of United—the first domestic airline to order jet transports—recognized this when the order for DC-8s was placed. It was our opinion that the long-term advantages of the DC-8 would outweigh this temporary disadvantage and that any diverted traffic would be regained quickly when DC-8 . . . service begins."

On this point, Northwest had this to say in its report:

"The fact that Northwest made final the jet purchase contracts in 1958, rather than two or three years earlier as was done by other major airlines, has resulted in certain benefits to your company." The carrier said it saved "substantial" amounts in interest on down payments and progress payments and added:

"Northwest will receive advanced-design versions of the DC-8 and the Electra; both airplanes will have improved fuel tank capacity over the original designs now being manufactured." The airline is scheduled to receive the first of its Electras in July and the first of its DC-8s in March, 1960.

Jet Financing

Reports covering details of financing programs to back the purchase of new equipment indicate that the general transition to turbine-powered aircraft—as it is now planned—is not likely to be marred by money problems.

Western Air Lines, which will begin service with its fleet of Lockheed Electras in June noted that no decision has been made to purchase turbojet equipment but that it is conducting surveys in hopes of finding an intermediate-range aircraft for its relatively short-haul routes.

Capital said the letter of intent given General Dynamics Corp. in 1958 was amended in 1959 to provide for the

First Continental Boeing 707-120 Makes Maiden Flight

First Continental Airlines' Boeing 707-120 jet transport makes its maiden flight at Renton, Wash. The airline has ordered four 707-120s with delivery scheduled in May. Continental will start jet service on June 8 on its Los Angeles-Chicago route, scheduling a nonstop flight time of 3 hr., 25 min., between the cities.

Third Convair 880 Jet Transport Makes Initial Flight

Third Convair 880 jet transport (Aircraft No. 2 is being used for nine-month pressure test program) makes its initial flight from Lindbergh Field, San Diego, Calif. First Convair 880 is at Edwards AFB, Calif., for flight test work and USAF demonstration flights.

purchase of 10 Convair 880 turbojets to be delivered between October, 1960, and March, 1961. Original order called for six 880s.

The report added that General Dynamics had agreed to "assist" the company in arranging the financing to cover the equipment cost, which is estimated at $45 million. Meanwhile, the airline is seeking a moratorium on its notes covering the purchase of 58 Vickers Viscount turboprops (AW Mar. 30, p. 43).

In this connection, under proposed amendments relating to the moratorium, Capital will be restricted in the purchase of new aircraft or the lease of aircraft without approval of the noteholders—Vickers-Armstrongs.

TWA Plan

Here is how TWA reports its future equipment program:

"Hughes Tool Co. has placed orders, under contracts assignable to TWA, for 15 707-131 aircraft, 18 Boeing 707-331 aircraft and 30 Convair 880 aircraft for delivery beginning in 1959. These contracts are subject to modification as to number and model of aircraft covered and as to specifications of the aircraft, including seating capacity. Hughes is not committed to sell any of these aircraft to TWA, nor is TWA committed to buy any of them from Hughes."

American points out that capital requirements for 110 new aircraft amount to $365 million. Approximately $79 million has been paid on the aircraft. A total of $85 million remains to be taken down in a long-term debt of $135 million. The balance of $200 million, according to the American report, will be paid for out of cash on hand, cash flow from depreciation, retained earnings, equipment sales and other sources.

Northwest reported that its financing program covering five DC-8s and 10 Electras at a cost of $67.5 million has been completed. Trade-in of the airlines 14 piston-engine planes with two manufacturers—Douglas and Lockheed—will provide Northwest with approximately $10.2 million.

Cash Payments

Eastern will make cash payments in 1959 totaling $70 million covering the balance of its 31-plane Lockheed Electra fleet to be delivered this year and the first of its DC-8 turbojet fleet. In 1958, Eastern made cash payments of $68 million for 17 Douglas DC-7Bs, nine Electras and deposits on its DC-8s.

Of the nine reporting carriers, three trunklines—each of which was grounded during the year because of strikes—showed a decline in revenues and operating expenses. Two airlines, Continental and TWA, reported net losses for the year.

Both Continental and Northwest reported a 22% increase in gross revenues, highest increase recorded by the group. Braniff reported a 72% increase in net income. Capital converted a 1957 net loss of $3.2 million into a $213,000 profit last year.

American's $16 million net profit was the largest reported by the nine carriers. Net profits reported by Western and Eastern were less than in 1957—all others reporting profits showed an increase in earnings. TWA's loss in 1958 was larger than its loss in 1957 but the carrier reported an operating profit of $10 million during the last six months of 1958, highest profit for the last half year realized since 1954 operations.

Continental's loss of $132,000 as compared with a 1957 net profit of $96,000 was attributed to transitional costs involving the switch from a regional type carrier with short-haul routes to trunkline-type of operations in long-haul high-density markets.

Labor disputes and the general business recession were held by the majority of carriers as factors in preventing the full development of revenue potentials during the year.

ATA Asks Withdrawal Of CAB Probe Order

Washington—Air Transport Assn. has asked the Civil Aeronautics Board to withdraw or modify its Mar. 10 investigation order in view of ATA's voluntary agreement to cooperate in the proceedings (AW Mar. 30 p. 42).

The latest ATA move, however, has no bearing on the lifting of CAB's subpena (AW April 6 p. 49).

Questioning the legality of what it terms "no more than a fishing expedition" and a "roving inquisitional investigation," ATA said that, since the results sought by the Board are being realized "without the necessity of legal process," CAB's formal order would appear unnecessary.

Meanwhile, a growing number of ATA carrier members have taken issue with the Board order through reconsideration petitions. Objectors, including American, National, United, Braniff and Delta, have demanded that CAB withdraw portions of its order calling for carrier members to force ATA to produce its records on grounds that the Board is exceeding its legal authority and is attempting "to accomplish indirectly what the CAB can not do directly."

They contend that, while CAB has authority to demand certain records and reports from air carriers, it is questionable whether the Board has any such power over an unincorporated association such as ATA.

United points out that, under the Federal Rules of Civil Procedure, such a organization may sue or be sued in its own capacity in connection with federal matters and is, therefore, recognized as an independent entity whose documents and papers are its own property and not those of its members.

Challenging the Board's legal authority to demand its records, ATA said CAB's doubt of its own power to do so became apparent when it recently asked congressional amendment of Section 407(e) of the Federal Aviation Act to extend the inspection powers of the Board to associations of air carriers.

Boeing Lists Pan American 707 Damage

By Russell Hawkes

Seattle, Wash.—Damage to a Pan American Boeing 707 jet transport, received during an abrupt descent over the Atlantic Ocean Feb. 3, ranged from wrinkles in the stabilizer skin to a "slight, permanent set" in the wings, Boeing Airplane Co. officials said during a Civil Aeronautics Board hearing here.

Hearings followed taking of depositions at New York (AW Mar. 23, p. 37) and were scheduled to continue last week in Los Angeles with Lockheed Aircraft personnel.

The aircraft apparently reached Mach .95 and later landed safely at Gander, Newfoundland.

In its official statement to the four-man CAB team, headed by Van R. O'Brien, Boeing said that the 707's autopilot disconnected in the incident and lack of Mach trim and crew inattentiveness resulted in the near-sonic dive.

Harold Hayden, Boeing structures engineer, who took part in the aircraft inspection at Gander, reported this damage:

- **Shear wrinkles** in rear wing spar web.
- **Slight permanent set** in wings which lifts the tips about 2¼ in. and twists the leading edge downward about ¼ deg. at the tips.
- **Partial failure** of No. 3 engine attach bolts.
- **Damage to right-hand** wing-body fairing.
- **Wrinkles** in stabilizer skin.
- **Slight buckling** in No. 2 nacelle skin and several floor beams just ahead of the juncture with aft wing spar where beams begin to pick up wing loads.
- **Failure in compression** of outboard aileron control rods which are designed to cope with compressive loads of high speed aileron up-float.

High Load Factor

Hayden concluded that damage had not been caused by travel of the center of pressure outside limits but by the high load factor with CP in the correct range. He estimated the load factor at five for an altitude of 10,000 ft. and speed of 450 kt. Damage to the tail was probably caused by heavy down loads when crews used extreme up-elevator during the corrective maneuver.

Hayden called the 2¼ in. permanent set in the wing "minor damage." He said that 24ST aluminum used in the 707 spars has a larger margin between yield strength and ultimate strength than most structural materials and that the airplane structure is just as safe to fly as it was before the accident.

In other testimony, Boeing aerodynamicist Joseph F. Sutter told investigators that the airplane undergoes a trim change at Mach .84 or .85, during which it loses its normal longitudinal static stability and tends to nose down and accelerate. At about Mach .94 the airplane recovers its static stability. Automatic Mach trim was designed to oppose this tendency and maintain longitudinal stability during the hiatus.

Boeing engineers were uncertain as to whether 707 operators had been advised to turn on the Mach trim before takeoff or after. Since that time, Federal Aviation Agency has ruled that Mach trim must be on at all times in flight. Installation of Mach trim is required by Civil Air Regulation Part .04B but it is not used by Air Force in its KC-135 jet tankers.

Boeing says the 707 can be operated safely without Mach trim but closer pilot attention is needed. Mach trim is automatically shut off when the autopilot is operating because static longitudinal stability is guaranteed by the autopilot.

In its official statement, Boeing reported that the autopilot disconnected in the Atlantic incident and lack of Mach trim combined with crew inattentiveness resulted in the near-sonic dive. Boeing studies indicate that if the 707 was trimmed for Mach .82 at the time of the accident, and a disturbance in-

Second Dart Herald Aimed at Asian, Indian Markets

Second Handley Page Dart Herald turboprop feeder-liner transport is making several demonstration tours to India and Asia. The first Dart Herald prototype crashed and burned Aug. 30, 1958, while en route to the Farnborough air show (AW Oct. 20, p. 123).

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Sud Caravelle Jet Transports Nears Completion

Five Sud Aviation Caravelle jet transports near completion at Sud's Toulouse production plant in France. Photo shows three Scandinavian Airlines System Caravelles, plus the second production Air France aircraft in foreground. Both SAS and Air France will begin Caravelle service on May 15. Sud will deliver 17 Caravelles this year and expects to reach monthly production rate of four by 1960.

creased the Mach number into the unstable region, a back pressure of 35 lb. on the control column would be needed to maintain altitude and prevent acceleration past Mach .9. Lacking this force, the airplane would nose over and accelerate to Mach .95 at which point stability would reappear.

Sutter said the 707 is laterally stable all the way to Mach .95 but above about Mach .93 flow over much of the wing has separated and very little skid would be needed to make flow over one wing separate earlier so the airplane would roll toward the wing where separation is most complete. He said that with the aircraft trimmed for Mach .82 and Mach trim turned off, the aircraft would tend to go into a spiral or Dutch roll, pick up speed in a phugoid oscillation and reach Mach .95 in about one minute.

A swept wing transport was said less likely to spiral than a straight wing design because it favors a Dutch roll mode which reverses spiral tendency. Sutter estimated, on the basis of a damage analysis, that the PanAm 707 had accelerated to somewhat beyond Mach .95. Maximum floor angle during the dive was estimated at between 10 and 15 deg.

Boeing tests run here after return of the aircraft found the Mach trim to function very close to design nominal values, engineers said. Mach warning bell was found to emit a buzz rather than the intended ring because of a loose center bolt. The bell also indicates high Q (dynamic pressure) at 380 kt. indicated air speed.

Autopilot disconnect warning light stopped functioning part way through the Seattle tests and the trouble was isolated in a relay. Boeing investigators found that the pitch trim potentiometer would not return to center when the autopilot was disengaged but discounted this as having any bearing on the accident. They reported that small errors would make no difference and large errors would make the autopilot noticeably overactive before the accident.

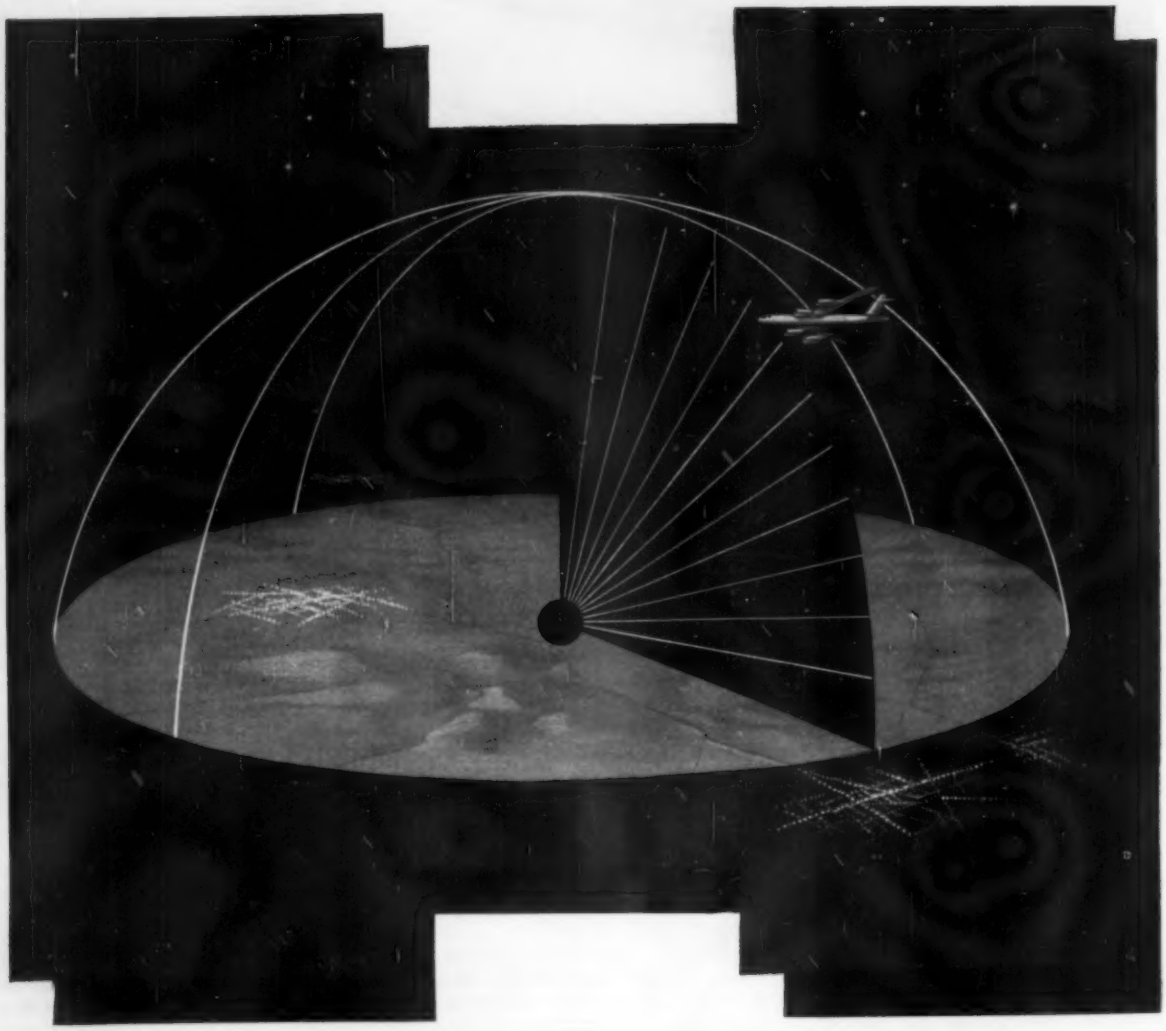
Boeing witnesses testified in regard to the effectiveness and safety of the autopilot comparator used with Bendix PB-20 autopilot to disconnect automatically if a discrepancy occurs between commanded control position and the actual one. They said that the comparator eliminates any inadvertant maneuvering at the moment of autopilot failure, which could be critical in a coupled approach and permits use of a wider range of control forces. They reported, however, that loss of the comparator would not result in a loss of safety. Autopilot cannot be engaged with comparator turned on if inoperative because of a failure, but it can be engaged after a comparator failure if the comparator is turned off.

Boeing engineer Paul Schumacher said he has seen no evidence to indicate that the passenger oxygen system failed to operate as it was intended to when pilot actuated the switch to eject passenger masks over their seats and only half actually popped out. He said that mask ejection is powered by the differential between oxygen manifold pressure and cabin pressure. Since there was no indication of a loss of cabin pressure during the accident it would not seem unusual for some of the masks to stay retracted. They are not intended to supply therapeutic oxygen.

Boeing engineers cautioned investigators about the reliability of data gatherd by a flight recorder which was installed in the left wheel well of the airplane. They said that flight test experience has shown the recorder to be resonant in a frequency range of about 10-15 cps. They said acceleration readings would be most heavily affected by this but also called speed values on the record "unlikely or impossible."

Recording is being analyzed by Lockheed Air Service at Ontario, Calif. and results will be reported in further depositions.

THE UMBRELLA



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To achieve umbrella-like radar protection Hughes engineers at Fullerton, California, have developed systems which position radar beams in space by electronic rather than mechanical means. These unique three-dimensional radar systems are digitally programmed to instantaneously detect high-speed enemy aircraft, even at low altitude.

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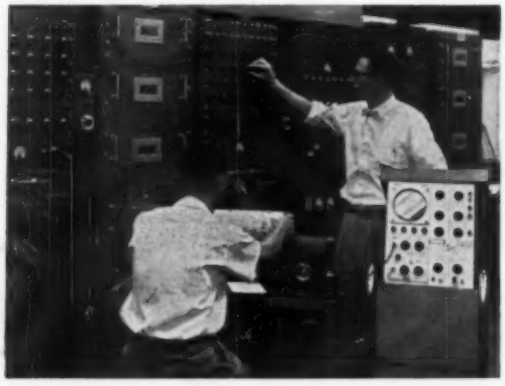
Other Hughes activities are delving into similarly advanced areas of electronics. Engineers at Hughes Research & Development Laboratories are probing into the effects of nuclear radiation on electronic equipment, studying advanced microwave theory and applications, and examining communication on a spatial scale. Applying this advanced type of creative engineering to commercial projects is the task of engineers at the Hughes Products activity.

The highly advanced and diversified nature of Hughes projects offers creative engineers and physicists the opportunity to build a rewarding career in a progressive and expanding environment.



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Write in confidence, to Mr. Tom Stewart, Hughes General Offices, Bldg. 6-A4, Culver City, California.

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INDIVIDUAL technical training of USAF personnel on the Jupiter intermediate range missile is followed by integrated weapon system training at this site at Army Ordnance Guided Missile School, Redstone Arsenal. Support vehicles are spread around the missile in approximately the pattern in which they would be deployed, but at shorter distances. Note H-frame and A-frame erector truck positioned by second missile in background. "Orange peel" shelter at base of missile protects personnel, equipment during maintenance and checkout.

Speed Marks Jupiter Development

By Evert Clark

Huntsville, Ala.—Jupiter intermediate range ballistic missile weapon system was brought into existence in less than one year.

Although the missile itself was ordered into development in the fall of 1955, work on the present ground support equipment did not begin officially until Jan. 2, 1958. Troop training did not begin until mid-February of last year.

This greatly telescoped schedule for proving the weapon, developing and producing its ground support equipment and training the crews to use it was met by an impressive amount of hard work and extremely close cooperation between the Jupiter's developer—the Army—its user, the Air Force, and the Jupiter contractors.

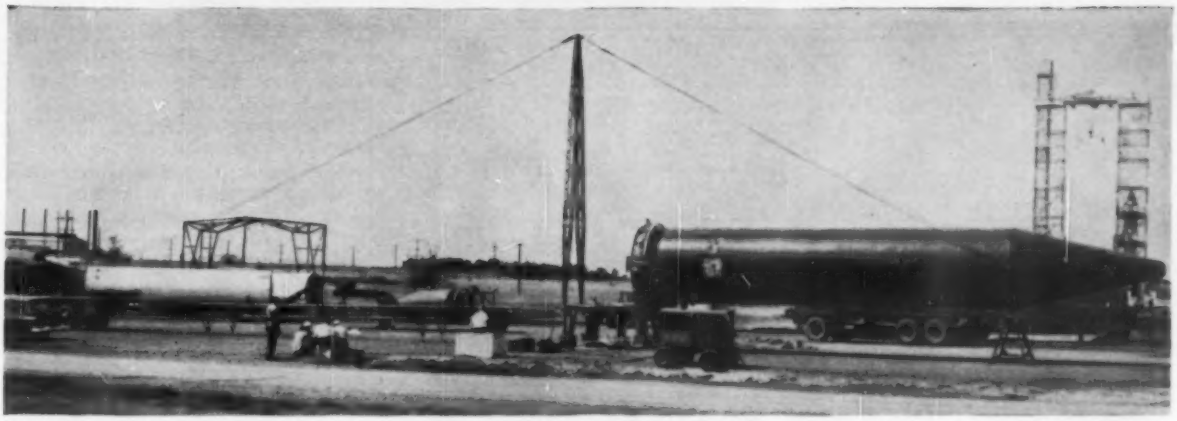
Jupiter did not always enjoy such a history. When its development was ordered by the President late in 1955, no provision was made for ground support equipment production or the other pertinent and necessary elements of a complete weapon system.

In November of 1956, the roles and missions issue was brought to a head by Defense Secretary Charles E. Wilson's order limiting the Army to deployment of missiles with ranges no greater than 200 mi.

This caused Army Ballistic Missile Agency to be limited to development of proving ground equipment and some planning for supporting equipment, but ABMA had neither authority nor funds to develop field equipment.

Another year of uncertainty followed

TECHNICIAN supervises emplacement of Jupiter IRBM at the training site used by personnel of the 864th Strategic Missile Squadron, first to be trained on the Army-developed missile.



BATTLESHIP version of Jupiter missile is used for training of USAF troops at Huntsville, Ala. Combination H-frame and A-frame hoist is used to position missile on simple mobile launcher.

while Defense Department evaluated design concepts and test firing results of the Jupiter and its Air Force counterpart intermediate range ballistic missile, the Thor, with an eye toward eliminating one of them.

Finally, in the fall of 1957, the decision was made that both weapons would be produced and that USAF would deploy both in Europe by the end of calendar 1958. Thor had almost an 18-month head start as a weapon system.

Development of supporting equipment for Jupiter was ordered immediately, but the directive was not clear-cut, and the result was that work began in several directions.

In mid-October of 1957, Army assigned Col. Thurston Paul, now deputy commander of Army Ballistic Missile Agency, to expedite the ground support equipment job. Shortly thereafter, USAF named Col. William C. Erlenbusch to head the first Jupiter unit—the 864th Strategic Missile Squadron (IRBM).

Army first reviewed the Thor equipment to see if it was compatible with the Jupiter. The hope was that one procurement and logistic effort could serve both missiles.

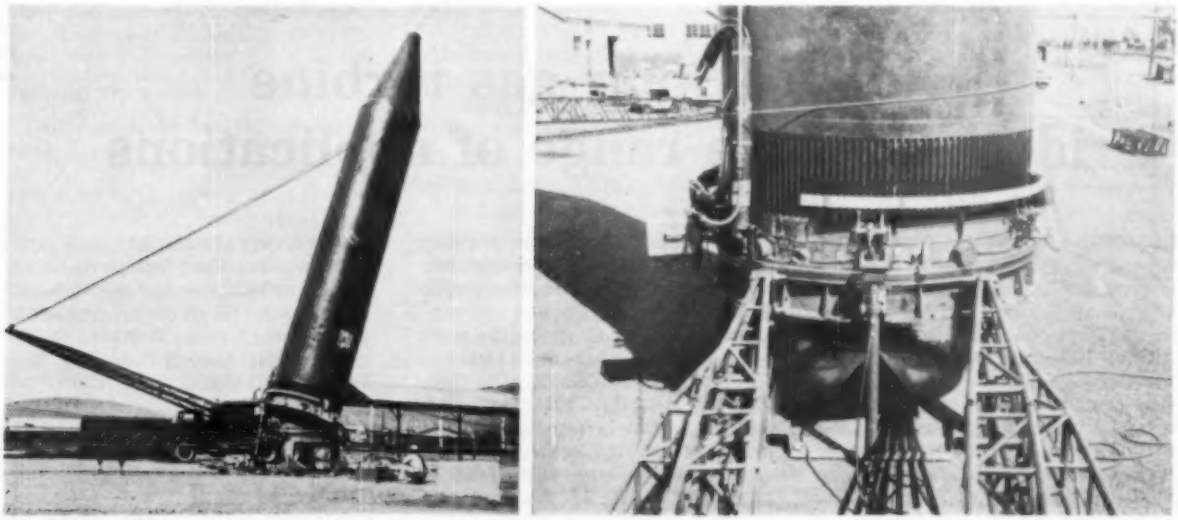
But the differences were many. The missiles have different weights, diameters, guidance and control systems, nose cone heat protection programs and other dissimilarities.

Thor is stored in a horizontal position and kept under a horizontal shelter that slides back on rails. Its erector is hinged to a concrete block that also serves as a launching pad.

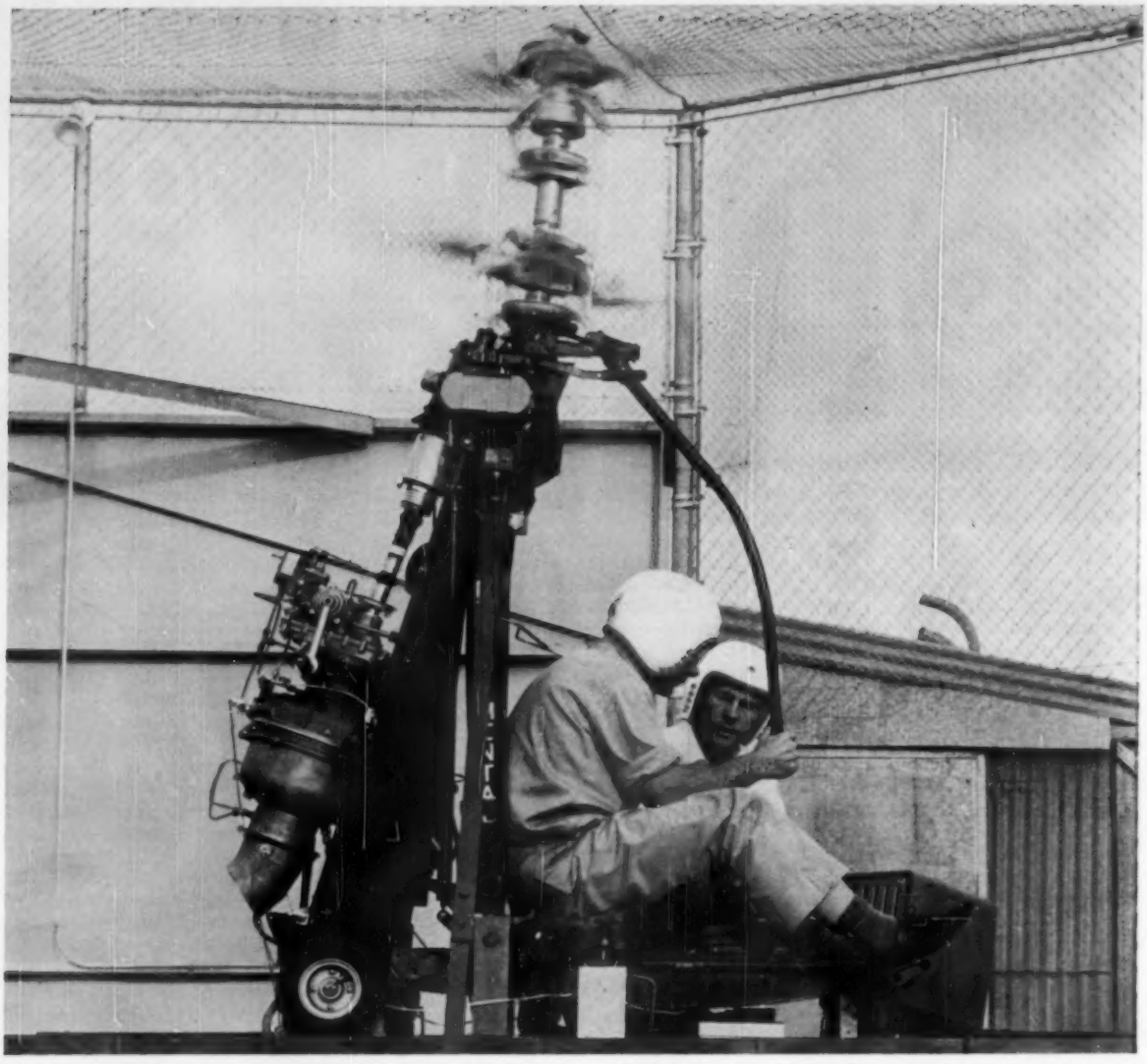
Jupiter is kept in a vertical position and is fueled that way. It sits on a simple launching table that also must be used to position it to the proper azimuth. Thor uses a skid-mounted liquid oxygen tank; Jupiter had planned to use three trailers. The Thor system used pressurization to feed propellants, while Jupiter used pumps.

At the end of October, 1957, Army Ballistic Missile Agency began trying to modify the design of the Thor equipment to fit Jupiter. By mid-December, Army had decided this couldn't be done if the time schedule was to be met due to lack of USAF contractors' production capacity, and both parties agreed that Army-designed equipment quite similar to the Redstone system would have to be used.

On Jan. 2, 1958, Army Ballistic Missile Agency finally got a firm directive, ended its divided design efforts and began developing an integrated support



SNUBBERS catch Jupiter missile (left) after center of gravity passes the point where the missile is hinged to the launcher. H-frame and A-frame can be dismantled in sections which two men can carry. At right, Jupiter is emplaced on mobile launcher.



Test of Solar Titan *gas turbine engine in one-man helicopter.*

Newest Solar gas turbine ideal for wide range of applications

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Missile Subcontracts

Army Ordnance Missile Command gives this breakdown on Redstone and Jupiter subcontracting by Chrysler Corp., the prime, from the period Oct. 1, 1956, through Sept. 1, 1958:

Total dollars spent in subcontracting to 2,409 companies, of which 1,935 or 80% were small business concerns, was $144,636,092. Of this, $117,018,268 or 81% went to large business and $27,617,823 or 19% to small business. Of the $117 million credited to large business, however, $101,185,689 went to the four major subcontractors—Ford Instrument Division of Sperry-Rand Corp. for guidance and control; Rocketdyne Division of North American Aviation, Inc., for propulsion; Reynolds Metal Co. for ballistic shells; and Hayes Aircraft Corp. for Jupiter ground support equipment—and much of it was in turn subcontracted to other companies. No breakdown is available on how much of this went to small business. Excluding the $101 million that went to these four contractors, small business directly received $27,617,823 of the remaining $43 million, or 64%.

system. It had the advantages of the already-developed Redstone system and its precautionary earlier planning for Jupiter to draw on, but it had the disadvantage of having only 12 months left in its time schedule.

Tactical planning conferences and training conferences followed quickly, and in February of 1958 the 864th went into training at the Army Ordnance Guided Missile School here. In March the Air Force's "Juplo," or Jupiter Liaison Office, was set up at Army Ballistic Missile Agency headquarters here to represent USAF's Air Materiel Command, Strategic Air Command and Air Training Command.

Tactical Operation

Last August the first tactical Jupiter missile was turned over to USAF and last Oct. 15 USAF personnel demonstrated the tactical operation of the first missile system, combining the Design Engineering Inspection and the Contractor Technical Compliance Inspection. Although some elements of Col. Erlenbusch's 864th finished training late in February, the squadron was ready last December to begin phased deployment abroad, meeting its time schedule.

The fact that negotiations with Italy and other North Atlantic Treaty Organization nations had not been completed by then apparently did not alter the training and support deadlines.

A second Jupiter squadron, the 856th, was activated last July and began train-

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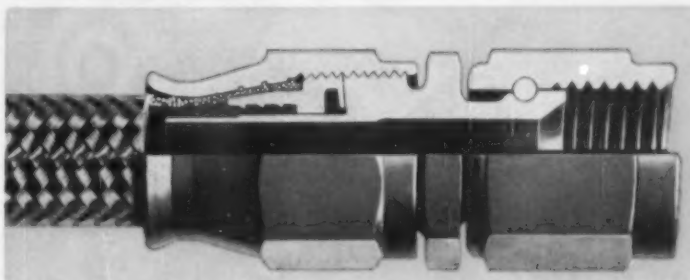

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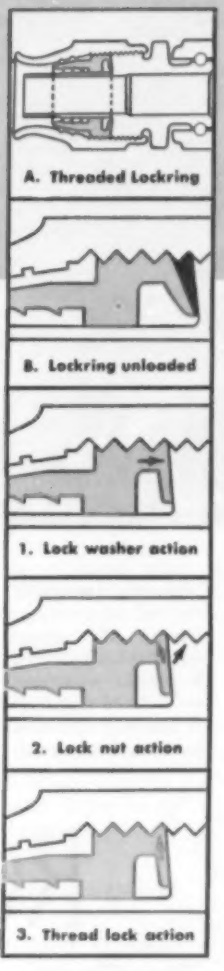

A Threaded lockring grips braid tightly; buried, it's tamper-proof.

B Before tightening—nipple about to contact coned disk of lockring.

1 Tightened . . . spring action of coned disk locks threads in compression.

2 Male threads are securely wedged against flanks of female thread.

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Propulsion through the ages . . .

Combination airplane-helicopter conceived by George Cayley, 1843

An astounding proposal : not a matched set of flying saucers, but the 1843 design of a combination airplane-helicopter by George Cayley. After vertical take-off, the four main rotors would adjust to flat pitch, thus making them wing-like appendages for level flight, propulsion provided by two pusher props mounted aft. A bird-beaked fuselage compounded the whimsey. A historical fact, however, is that the brilliant Yorkshireman made the first successful heavier-than-air craft — the small kite-glider shown above in the hands of an admirer. A later historical fact is that Rotol people designed, developed and produced the propellers for the first turbo-prop aircraft to fly (1945) and since then have supplied turbo-props to over 100 airline and aircraft operators throughout the world who attest to Rotol reliability. Rotol props are standard equipment on the Vickers Viscount, Fairchild F-27, Grumman Gulfstream and Fairey Rotodyne.

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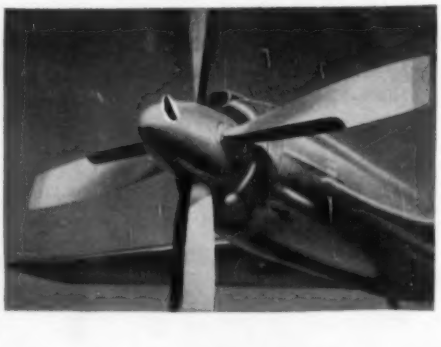


Rotol Incorporated after-sales service throughout the United States provides immediate spare parts delivery, technical service on propeller operations and applications.

For information on Rotol products and after-sales service, call J. Staples, President, Rotol Incorporated, 409 Jefferson Davis Highway, Arlington 2, Virginia. Phone OTis 4-6290

ing just after Christmas. Its training time will be considerably shorter than that of the 864th because complete Jupiter systems will be available throughout the period and because the cycle has been telescoped through feedbacks that the 864th was able to make to the school.

The 866th Strategic Missile Squadron (IRBM) has an operations and a maintenance officer here now, observing the other units and preparing for activation of their squadron sometime this summer.

In addition, Detachment One of Strategic Air Command's 704th Strategic Missile Wing (ICBM) is based here to help provide continuity in the training mission and the basing of the USAF troops.

A Jupiter squadron consists of 15 missiles and about 500 men. Missiles are deployed three to a site at five sites scattered around a Receiving-Inspection-Maintenance area at distances up to 100 mi.

A launch crew consists of one officer and two airmen who control the three missiles at any one site. Thus 15 men could launch 15 missiles. The three-man launch team operates from a Launch Control Trailer located far enough away from the missiles to be safe from a propellant explosion.

There is virtually no possibility of an explosion of the nuclear warhead, which is not armed until a long sequence of steps, including flight, have been performed.

Squadron Organization

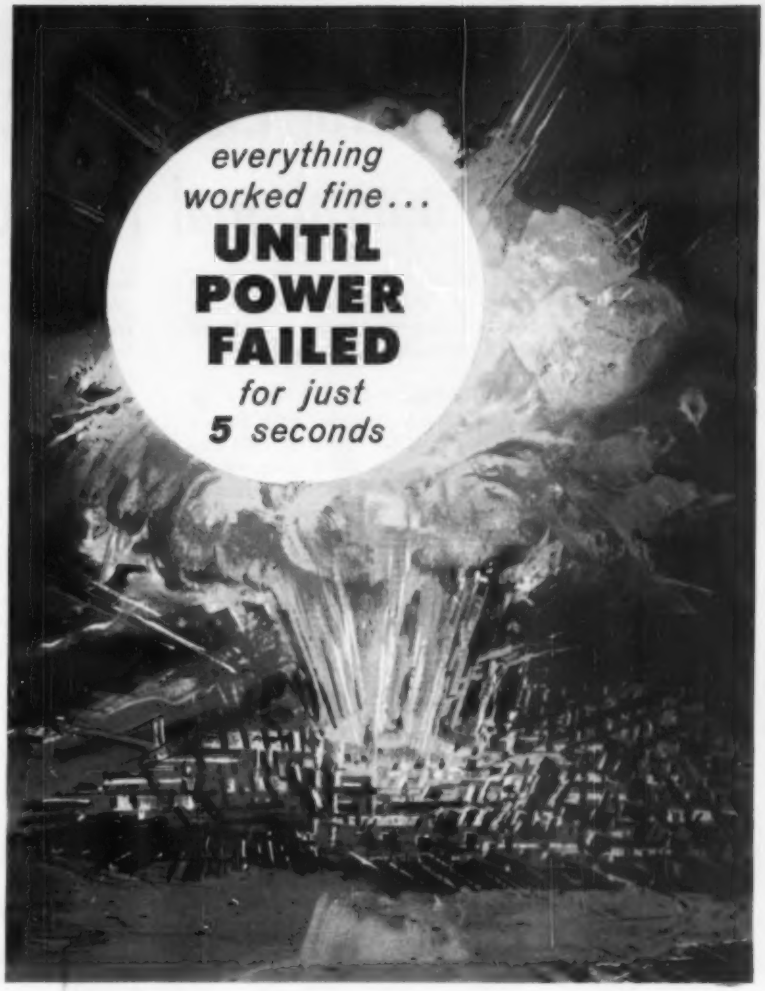
The squadron is organized into operations, materiel and maintenance sections and includes about five logistics specialists. The operations section is broken down into five "flights" or groups of launching crews. In the case of the 864th, they are designated Flights A through F.

Each flight consists of five officers and 10 airmen. Since only 15 men are required to launch the 15 missiles, this total of 75 men means that each missile is manned in a five to one ratio— so that crews are available for three shifts a day on a 24-hr. day, with a spare crew to take care of weekends and another to take care of men on leave.

SAC's goal is a 15-min. reaction time alert to firing.

About 80% of the 500 men in a squardron are technicians and the remainder are in communications, supply, security and other functions. The ratio of four to one holds for both airmen and officers.

A Jupiter emplacement requires about 20 vehicles and a "banana peel" folding shelter around the base of the missile. Transporters and erectors can serve more than one missile, and a Launch



"We had five fast moving bogeys in radar contact and had started the defense process. Then... power failed. In five seconds we were back in business, but our scopes showed only four targets. We passed on the information. Defense got all four... but the fifth got through..."

Don't risk this possibility. Con Diesel can supply standby power units which, in the event of power failure, will restore FULL VOLTAGE in 1.5 MILLISECONDS. In this hypothetical situation, the scopes wouldn't even have flickered, let alone gone out completely.

We call this unit Model UPS... Uninterrupted Power Supply. Diesel-engine driven models are available in sizes from 10 to 200 kilowatts. Automatic controls start the engine only when it's needed; operating costs are negligible.

A phone call, wire or letter will arrange a demonstration at our plant.

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Aircraft Equipment Div. • Test Equipment Div. • Consolidated Controls Corp. Consolidated Avionics Corp. • Lima Electric Motor Co. • Hammond Valve Corp.

Progress in Space Technology

How General Electric delivered first U.S. operational re-entry vehicle

General Electric Missile and Space Vehicle Department helped USAF Ballistic Missile Division solve re-entry problem . . . speed Thor operational readiness.

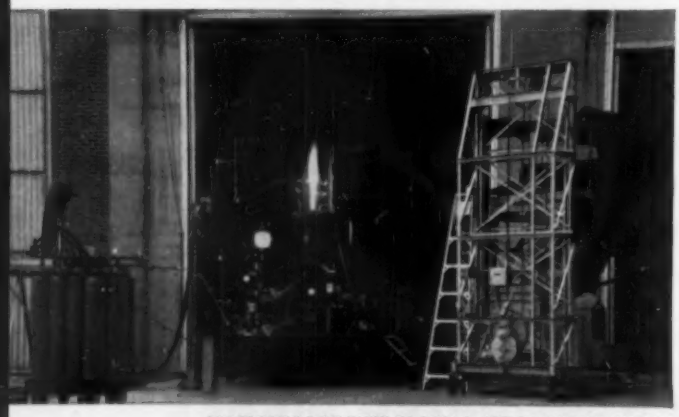
CAPABILITIES DEVELOPED RAPIDLY—Early in 1955, General Electric's Missile and Space Vehicle Department began research and development work on the vitally important re-entry phase of the USAF ballistic missile program. A skilled core of G-E scientists with hypersonic and missile technology experience were pulled together from all parts of the Company. Special research tools were developed and put into use at MSVD's new Aerosciences Laboratory. Advanced shock tunnels reproduced high Mach air flows—10,000 to 25,000° F plasma jets simulated extreme re-entry heats. With such new tools, G.E. gained vital knowledge of the re-entry environment.

FLIGHT TEST PROVED DESIGN—MSVD engineers were convinced that the heat-sink type re-entry vehicle offered the best approach to providing the Air Force with an *operational* weapon at the *earliest possible date*. Later, flight tests proved the soundness of the General Electric approach. On schedule, only 30 months after research and development began, the Air Force launched the free world's first operational re-entry vehicle on Thor.

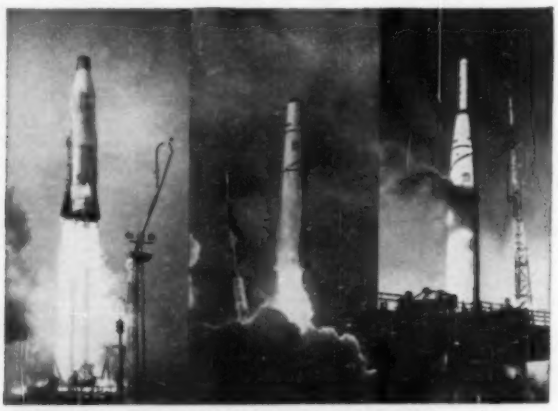
Missile and Space Vehicle Department engineers were also able to make important advances on other fronts associated with the re-entry challenge. Complex re-entry vehicle ground support equipment was developed; rocket-sled tests aided in solving fuzing problems. It was also necessary to build one of the country's most advanced data processing and computation centers to keep pace with the need for rapid processing of Air Force re-entry data.

PRODUCTION ON SCHEDULE—To prepare for Thor missile re-entry vehicle production, General Electric acquired and developed special manufacturing facilities and techniques. Proof of the smooth, rapid transition from research and development to production is the fact that Thor re-entry vehicles have passed *all operational qualification tests* and are being delivered on schedule to the Air Force for air lift to key overseas bases.

ADVANCED NOSE CONE DEVELOPMENT—Meanwhile, development continues on more advanced re-entry vehicles. Last year, one such G-E re-entry vehicle, the Thor-Able, successfully re-entered at an ICBM range of over 5500 nautical miles. With more than four years of success as an associate contractor on the Atlas, Thor and other programs, *General Electric is the leader in re-entry vehicle development and production experience.* This proven competence will continue to grow as MSVD applies its re-entry experience to the expanding list of new missile and space projects. *Missile and Space Vehicle Department of the Defense Electronics Division.* 224-50



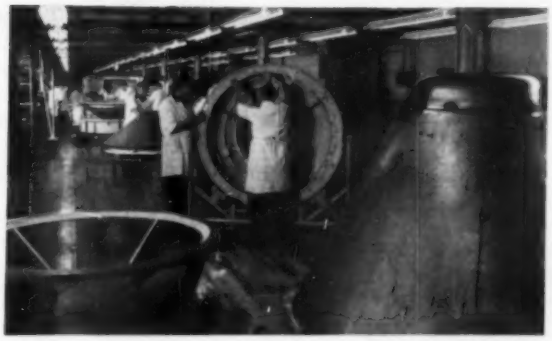
NATION'S LARGEST PLASMA JET PLAYS KEY ROLE in providing information leading to the solution of the re-entry problem. Plasma Air Arc and many other re-entry research tools were developed by MSVD Aerosciences Laboratory scientists.



OVER 1½ YEARS OF FLIGHT TEST EXPERIENCE on Atlas, Thor and Thor-Able missiles has been gained by General Electric covering both heat-sink and ablating types of re-entry vehicles for the USAF. These three ballistic missiles are pictured above.

A GENERAL ELECTRIC RE-ENTRY VEHICLE is mated to a Thor Missile in the first SAC operational test flight exercise from Vandenberg Air Force Base.

Official U.S. Air Force photograph



RE-ENTRY VEHICLES ARE ASSEMBLED at MSVD facilities in Burlington, Vt., for both THOR and ATLAS ballistic missiles.

These Free Booklets Describe MSVD Ballistic Missile Re-entry Vehicle Work.

Indicate the brochures that you would like to have and send to: Section A224-50, General Electric Co., Schenectady, New York.

Capabilities of G.E.'s Missile and Space Vehicle Department	**GEA-6904A**
Space Technology Progress	**GEA-6876**
Heat Sink Nose Cone	**PIB-2**
Design and Fabrication of Re-entry Vehicles	**GER-1583**
Heat Protection of Re-entry Vehicles	**GER-1582**

Progress Is Our Most Important Product

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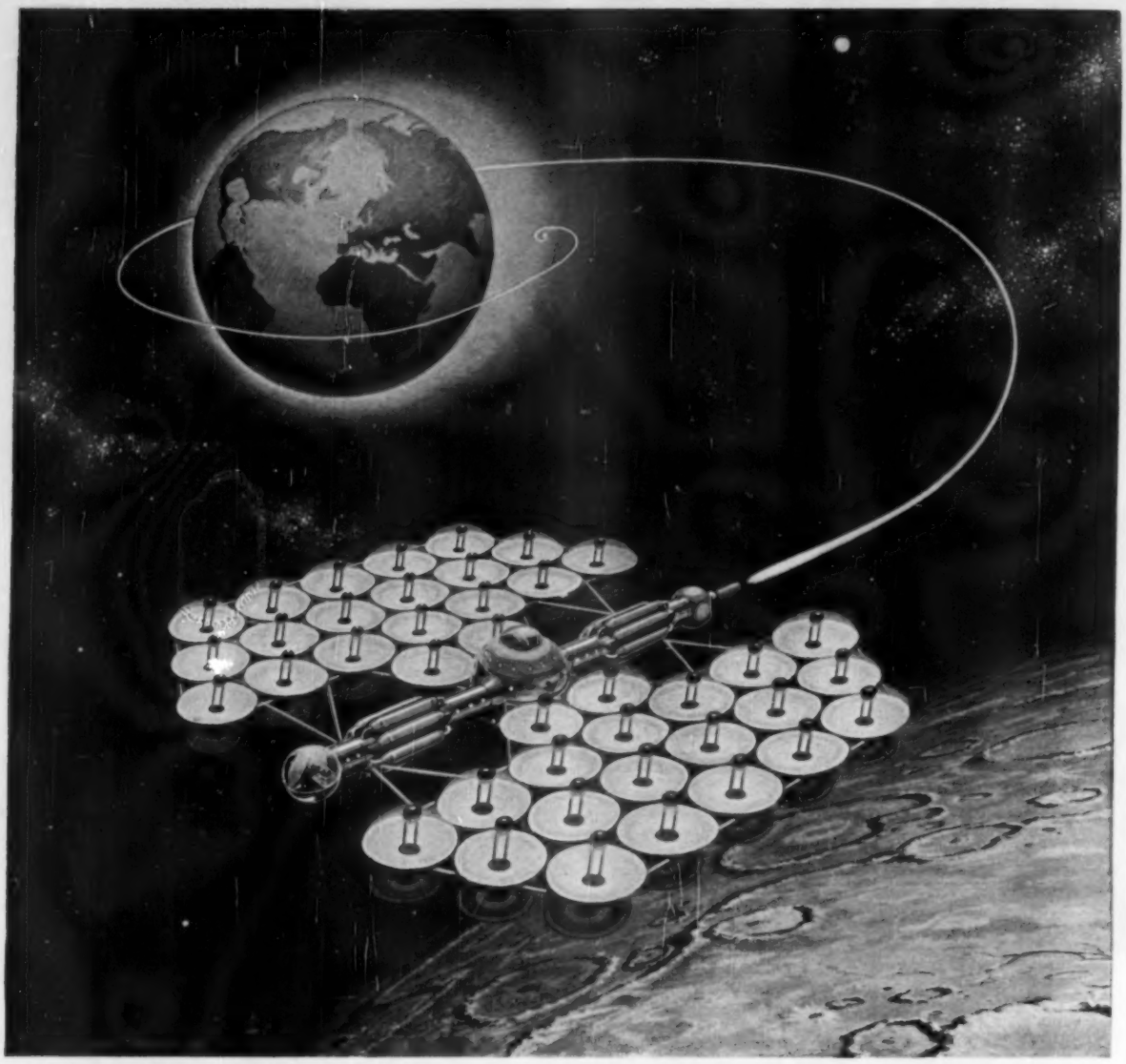

STEPS IN THE RACE TO OUTER SPACE

Cosmic Butterfly

Spreading its wings to absorb the eternal flow of solar energy is the Cosmic Butterfly, a space vehicle of a type first conceived by Dr. Ernst Stuhlinger of Redstone Arsenal.

Each of the fifty-foot parabolic mirrors in the wings concentrates the Sun's rays on a boiler at its focal point. Steam is developed, which drives a 200-kw turbo-generator in the base. Cooled by frigid outer space in heat diffusers, the steam reverts to water and is pumped back to the boiler to be used over and over again.

The current thus generated drives the main propulsion unit, an ion rocket in which powerful electric fields accelerate charged particles, shooting them from the rear of the rocket exactly as the electron gun in your TV set bombards the screen. Sunlight, then, is the power source, whereas cesium is the propellant.

While the recoil thrust is relatively small, the weightless vehicle is operating in a vacuum and the push is enough to enable the Butterfly to reach interplanetary speeds. Unlike conventional rockets, the Butterfly is under power the entire trip. Half way to its destination it turns around, and the ion thrust is used to slow the craft down to arrival speeds.

Since its thrust is entirely inadequate to cope with the gravity of major planets, the Cosmic Butterfly never lands. It is assembled in space and shuttles between artificial satellites.

The Cosmic Butterfly could carry ten passengers and 50 tons of cargo from an Earth satellite to a comparable one orbiting around Mars in about one year of continuous travel.

Inertial navigation systems will play an increasing role in the exploration of outer space. ***ARMA***, now providing such systems for the Air Force ATLAS and TITAN ICBM's, will be in the vanguard of the race to outer space. ***ARMA*** . . . Garden City, New York. A Division of American Bosch Arma Corporation.

AMERICAN BOSCH ARMA CORPORATION

Control Trailer serves three missiles, but other vehicles must be emplaced with each missile.

Launch crews can inspect and ascertain readiness of their equipment but more complex work requires mobile maintenance crews. One maintenance crew is stationed at each launching position on a normal daylight shift, and two crews are available to be dispatched from the Receiving-Inspection-Maintenance area graveyard and swing shifts for emergencies.

Mobile maintenance crews and the recycling crews, kept at the Receiving-Inspection-Maintenance area for yearly overhaul of the missiles, can be interchanged.

With a minimum of training, maintenance men could be shifted to launch crews. USAF plans as much rotation of men to other jobs when possible. With some training, mostly as crews rather than as individuals, Jupiter squadrons could also be trained for Thor operations. However, except in the propulsion area, maintenance personnel would require extensive specialized retraining.

Training Cycle

The 864th's training cycle was broken into four main phases. Since the Army's 40th Field Artillery Group was almost through with its Redstone training, and since Jupiter systems were not then available, Col. Erlenbusch's men went into individual-skill training on the 200-mi. range Redstone on Feb. 15, 1958.

Next came crew training on the Redstone, which is similar in components and almost identical as far as the overall system goes. This was followed by individual training on the Jupiter and finally by Jupiter crew training at the Integrated Weapon System Training site, a large cleared field on the Redstone Arsenal grounds providing a complete emplacement of a Jupiter system. Training staff at the Integrated Weapon System Training site consists primarily of engineers from Chrysler Corp., prime contractor for the Jupiter.

When the 864th is deployed overseas, it will go as a technical training squadron and not as a strategic missile squadron. Troops of the North Atlantic Treaty Organization country or countries that accept the Jupiter will send technicians to Redstone for individual training and then return them to Col. Erlenbusch's squadron for crew training. A small field detachment from Air Training Command has trained with the 864th and will remain with it through NATO training.

Control of nuclear warheads will remain with U.S. troops. The squadron will take with it about 40 contractor field engineers. The group would be reduced in one year to about one-third that number. Chrysler would decide the proportion of Chrysler personnel to those of Rocketdyne Division of North American Aviation, Inc., the engine manufacturer; Ford Instrument Division of Sperry-Rand Corp., the guidance manufacturer, and so on.

The 864th's situation differed from Thor training in two important ways:

- **Jupiter training is conducted** by military technical schools, while that of Thor is conducted primarily by contractors.
- **Since no NATO country** had agreed to take the Jupiter, a complete USAF squadron had to be organized and trained. On Thor, a cadre of USAF personnel was trained and then went immediately into the task of training the British troops who are deploying the Thor.

About 95% of the squadron's training has taken place at Redstone, but some personnel have had additional training at the Army Engineers' 20-ton liquid oxygen generating plant at Ft. Belvoir, Va., and USAF's 100-ton plant at Vandenburg AFB, Calif. Checkout and assembly of warheads has been taught at Lowry AFB, Colo. by USAF personnel who were trained by Army at Picatinny Arsenal. Some of those with warhead training move in and train with squadron crews and others will meet them overseas.

Jupiter firings have been witnessed by 90% of the officers and many of the airmen of the 864th at the Air Force Missile Test Center's launching complex at Cape Canaveral, Fla. There is a program, still several months away, that calls for squadrons to fire Jupiters from Cape Canaveral under operational conditions, and there is equipment in the Jupiter program for this.

Once the squadron is overseas, a few men at a time would be rotated home to Cape Canaveral for firings. Some Air Research and Development Command personnel have gone through the school. They would remain at Cape Canaveral to maintain continuity, receiving and checking out the missiles and turning them over to operational launching crews.

Proficiency Maintained

Before the 864th was ordered to deploy, it gained a few bonuses and maintained its proficiency by witnessing firings, taking part in small groups in research and development firings with Army Ballistic Missile Agency's launch crews at Cape Canaveral, and assisting in checking out and packaging of Jupiter systems for overseas shipment.

The 864th can supply, administer and maintain the weapon system and itself, but it will need a support squadron for feeding, transportation, maintenance of vehicles, etc. It will follow the Strategic Air Command bomb wing concept of always being attached to a base.

The deployment concept also follows USAF policy of allowing families to travel with the squadron if possible, especially where tours may run to several years. It is not the intent of the United States to operate intermediate

JUPITER'S guidance and control components are basically the same as those used on Juno II space probe. Computers and other instruments were made by Ford Instrument Division of the Sperry-Rand Corp. for Army Ballistic Missile Agency.

WIRE HARNESS for the navigation system of Convair's B-58 Bomber is insulated with TEFLON TFE-fluorocarbon resins for maximum reliability in a high-ambient-temperature environment. Engineers of the Sperry Gyroscope Company, which developed and is producing the B-58 bomb-navigation system, have also found that considerable cost savings are possible in assembly, because TFE resins do not melt, flow, embrittle or shrink back even after prolonged contact with a soldering iron or solder pot.

Wire and cable insulated with "TEFLON" TFE resins withstand continuous high ambients in the toughest services

With TEFLON TFE-fluorocarbon resins, you obtain a built-in safety factor. No other wire and cable insulation offers you so great a latitude in overcoming temperature problems and accidental overloads. Wire and cable insulated with these resins are rated for continuous service at 260°C. Yet recent tests have shown that in some cases the useful wire insulation life of TFE resins is greater than 1,000 hours at 350°C. (662°F.) and 100 hours at 400°C. (752°F.). The heat-aging data below shows that even after 6 months at 300°C. (572°F.) the excellent electrical properties of TFE resins are unchanged, and considerable mechanical toughness is retained.

So if reliability is your prime requirement—in assembly, production, storage or service—specify wire and cable insulated with TEFLON TFE resins. Often, this is the least costly way to achieve a design objective. See your local supplier of this wire and cable for an engineering approach to your wiring reliability problems.

You'll find him listed in the Yellow Pages under "Plastics—Du Pont". Or, for detailed technical data on these resins, write: to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Rm. T-7413 Du Pont Building, Wilmington 98, Delaware. In Canada: Du Pont of Canada Limited, P.O. Box 660, Montreal, Quebec.

EFFECT OF HEAT AGING

Results of oven aging at 300°C. (572°F.)*

	ELECTRICAL			MECHANICAL					
Exposure time at 300°C.	Dissipation Factor –	Dielectric Constant	Dielectric Strength (volts/mil) ASTM D-149	Yield Stress (psi)		Yield Elongation (%)		Tensile Strength (psi)		Ultimate Elongation (%)	
				MD**	TD***	MD	TD	MD	TD	MD	TD
As received	0.0001	2.03	2930	4970	2100	74	3.8	6780	4790	190	640
1 month	0.0001	2.08	2830	3880	2290	71	2.8	5740	3670	320	910
3 months	0.0001	2.08	2890	3920	2420	75	3.0	5000	3340	300	955
6 months	0.0001	2.11	2950	3540	2320	82	2.5	4150	2430	296	982

*5-mil film samples of TFE-fluorocarbon resins **MD—Machine direction ***TD—Transverse direction
Tests performed at room temperature following heat aging

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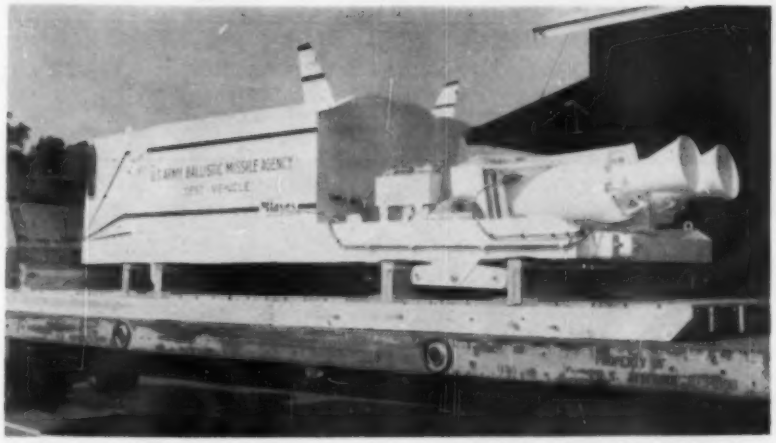
TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.



ROCKET research sled for use at Naval Ordnance Test Station, China Lake, Calif., is one of many items of Jupiter test and support equipment developed and produced by Hayes Aircraft Corp. Chrysler Corp. and Hayes were two principal ground support suppliers.

range ballistic missile units on foreign soil for any longer than is necessary to train a NATO country's troops and eventually be replaced by them.

Jupiter deployment precludes the use of any site for farming or cattle raising. Sites must be completely secure, like any other Strategic Air Command emplacement. Where troops are not able to live at a base, they will live in nearby towns.

Strategic Air Command found little trouble in recruiting personnel for missile squadrons. As an example, Col. Erlenbusch cited an air crewman who gave up flight pay and his spot promotion to get into the 864th. Convair B-36 radio operators, who found themselves too long away from electronics theory, had some trouble with the Guided Missile School's requirements, but on their own initiative they studied at night and caught up with the requirements, Col. Erlenbusch said.

Armament and electronics crews from Strategic Air Command, familiar with bombing and navigation systems, proved to have good aptitude for missile work and had very little trouble shifting over.

Rocket Technology

Those familiar with jet engines had little trouble shifting to rocket propulsion technology. About the only new areas that missiles presented were liquid oxygen generation and propellant handling. Receiving - Inspection - Maintenance areas for a Jupiter squadron will house a 25-ton liquid oxygen and nitrogen generation plant. Trucks will be sent out to missile sites several times a week to top off tanks.

Jupiter as a weapon system now incorporates more tactical mobility than USAF is likely to use. Sites could be vacated or relocated more quickly than with Thor at no loss to the fast reaction time. One third of the squadron can remain in place with a theoretical countdown time of 15 min., another third can remain in place and one hour away from launch, while what the Army calls "the circus" of vehicles for the last third is on the road.

Engine Alignment

Thor's hydraulic ram and shelter, although more costly and permanent than the Jupiter emplacement, has the advantage that it can be used for some larger-echelon maintenance, such as engine alignment, that must be done at Jupiter's Receiving-Inspection-Maintenance area.

Although both missile systems are strategically mobile, both would require a considerable amount of airlift for any rapid strategic deployment.

Development of Jupiter's ground-based gear generally followed the pattern of the Army Ballistic Missile Agency's Support System Equipment Laboratory's work on Redstone. Most of the USAF inputs were human engineering requirements for the simplest possible go no-go presentation of information in the checkout and countdown sequence. The resulting system is similar to Thor but quite different from Redstone in the degree of automation.

Check Lists

USAF developed check lists that had built-in emergency procedures where the rapid missile sequence of events leaves no time for decision-making.

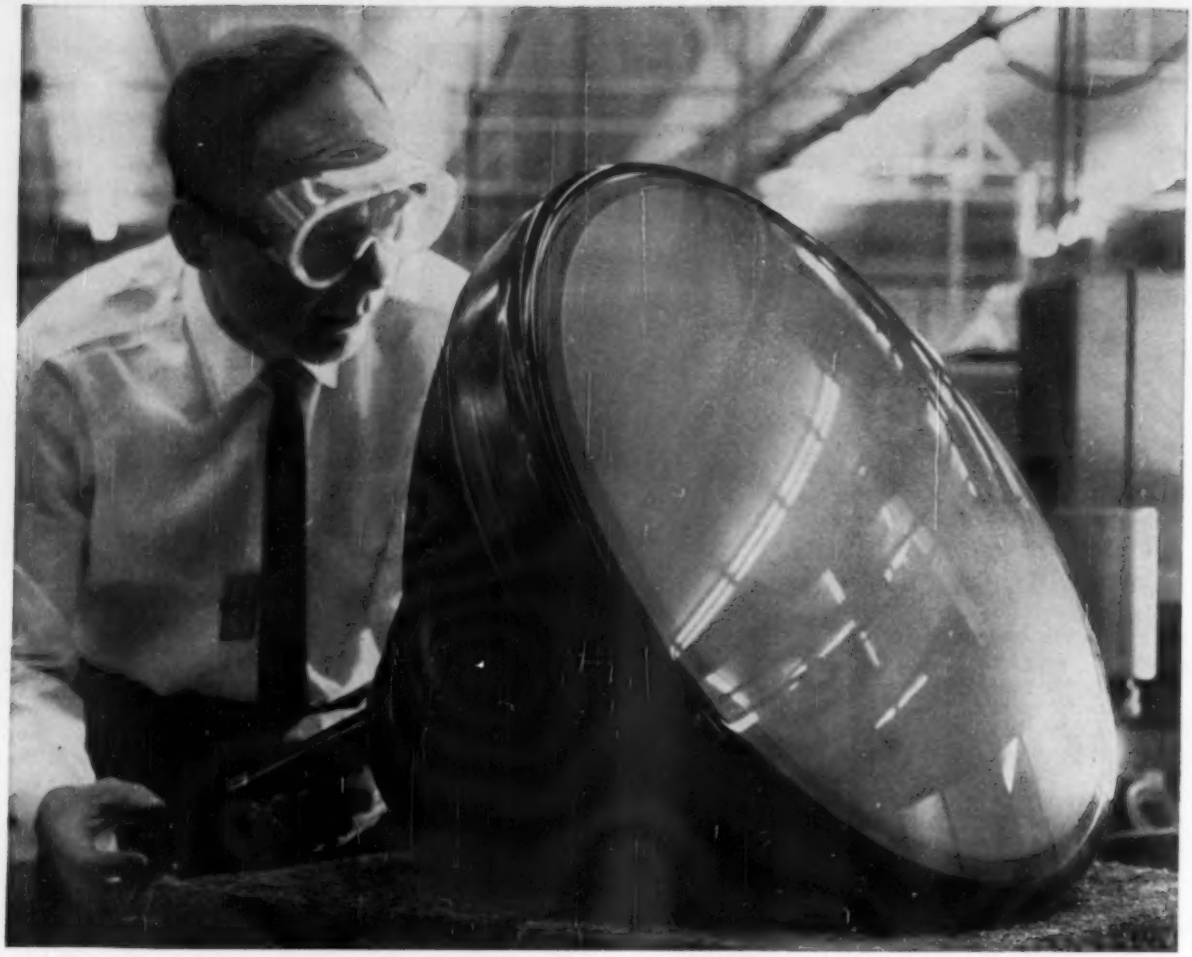
The system includes an Electronic Equipment Trailer that will give the status of the checkout or countdown procedure at any time, and a Fault Isolation Trailer that can be linked between the ground equipment and the missile to pinpoint troubles. This trailer also can simulate the missile's functions, so that it can serve as a training simulator as well as a trouble-finder.

Malfunctions

With this arrangement, malfunctions can be fed into the system by the commander for crews to find. The system can be sequenced to run through the entire Jupiter procedure from the first checkout step through simulated flight and impact on target.

Bulk of the research and development work and prototype manufacturing on support equipment was done for Army Ballistic Missile Agency and USAF by Chrysler Corp. and Hayes Aircraft Corp. of Birmingham, Ala. and the major subsystem contractors. Chrysler and Hayes are doing most of the production manufacturing and assembly, with Chrysler, which has systems compatibility responsibility, gradually bringing more of the work into its own house. Hayes continues to do a large

"ORANGE PEEL" shelter at the Jupiter base (open at left) protects men during checkout.



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The Hughes 21" TONOTRON* tube offers you a new level of sophistication in displays for: Air traffic control, Combat situation plotting, Radars, Large-scale read-out, Medical diagnosis, Industrial television, and Slow-scan displays.

This new TONOTRON tube provides high light output, integration abilities, full gray scale, controllable persistence, and a very large display area—all in one envelope!

Hughes also announces a 21" character-writing TYPOTRON® storage tube, which gives you the *added* capability of high-speed digital character display. The 21" TYPOTRON tube is ideally suited for any of your digital read-out requirements. In addition, this unique TYPOTRON tube offers you either character read-out or spot writing modes—or a combination of both capabilities.

Both the 21" TONOTRON Tube and the 21" TYPOTRON tube are now available for delivery. For additional information please write: Hughes Products, Electron Tubes, International Airport Station, Los Angeles 45, California.

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amount of the work, having reached a peak and leveled off last November.

All trailers are government-furnished equipment, supplied through Ordnance Tank Automotive Command, with Bowen-McLaughlin manufacturing most of the larger ones and Lynn Coach and Truck Co. the smaller ones. Other contractors include Willys Motors, Inc. and Curtiss-Wright Corp. Trailers come to Chrysler or Hayes with modifications including heaters, air conditioning, electrical fittings, etc. Fruehauf Trailer Co. provided all the missile transporters.

An example of how the systems' contracting works is the Electrical Equipment Trailer, the most difficult, expensive and critical of the group. Research and development was generated by Army Ballistic Missile Agency and Hayes. Most of the early work was done by Hayes, with the trailer built by Lynn Coach and components being supplied by North American Aviation, Picatinny Arsenal, Norden-Ketay Division of United Aircraft Corp., Ford Instrument Division, etc. Chrysler now is going in-house on this piece of equipment.

Component Suppliers

Chrysler supplies the bulk of the testing and servicing equipment for the Receiving-Inspection-Maintenance area. Picatinny Arsenal supplies most of the testing and handling equipment for the warhead. Vertical tail shelter is supplied through the Corps of Engineers by Barnes & Reinecke, Inc.

The 6,000-gal. fuel semi-trailer is supplied by General Steel Tank and the 4,000-gal. liquid oxygen semi-trailer and liquid oxygen-nitrogen generating plant are supplied by Air Products.

Linde Co. Division of Union Carbide Corp. supplies the nitrogen service trailer. Chrysler and Hayes supply most of the access platforms, ladders, cable mast assemblies, liquid oxygen replenishing arm assemblies, etc.

Watertown Arsenal supplies the launcher to Chrysler for outfitting.

Communications equipment is procured by Chrysler from North Electric Co. and is allocated to vehicle suppliers. This is done to maintain an orderly flow.

Army Ballistic Missile Agency personnel were forced to considerably accelerate the usual documentation, production and supply function because of the unusually short time from research and development to volume production of ground support equipment.

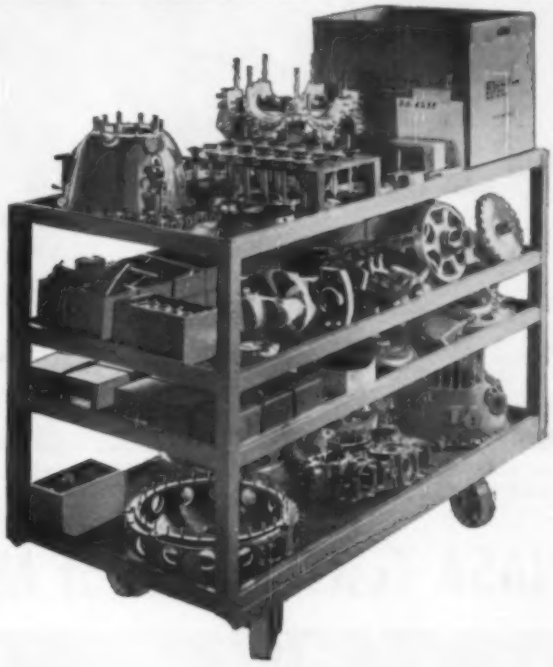
This ranged from preparing detailed agreements on which service and which bases in Europe would supply each small item and freezing items in depots there, to deciding whether a missile would be flown by USAF from one European location to another or moved by the Army by train.

By September and October of last year there was no doubt that the Dec. 31 deadline would be met. Both services credit the success of the entire operation to a very high degree of cooperation, and both Air Force and Army men at the working levels in the Jupiter program speak of this cooperation with a good deal of pride. None of the bitterness generated during the discussions at higher levels of roles and missions and relative values of weapon systems is evident now in the developing agency or the using squadrons.

WADC to Research High Heat Compound

St. Louis, Mo.—Wright Air Development Center has contracted with Monsanto Chemical Co. for a research quantity of a polyphenyl ether for testing as a high temperature functional fluid.

The polyphenyl ether was developed for USAF for possible use as thermally stable lubricants, hydraulic fluids and greases. Monsanto has concentrated on the polyphenyl ether compounds for service over a temperature spectrum of up to 800F (AW Sept. 29, p. 57).



THIS IS ENGINE E7592

Airwork never scrambles engine parts on a mass production basis. When this engine was torn down for overhaul—the parts went on this cart. The cart kept all re-usable parts together as they went through Cleaning, Inspection and Rework. Now, new parts have been issued. The cart is ready to start through Assembly.

These carts preserve your investment. If a vital part has a potential 10,000 hour life—and you have used it for 1,000 hours—that's the one that goes back on your engine. Under the usual shop system, you could end up with a 9,000 hour part . . . and a big bill next time.

Mating parts that have "worn in" are re-mated. And . . . you get individual treatment of the operating problem shown by the internal condition of your engine at overhaul.

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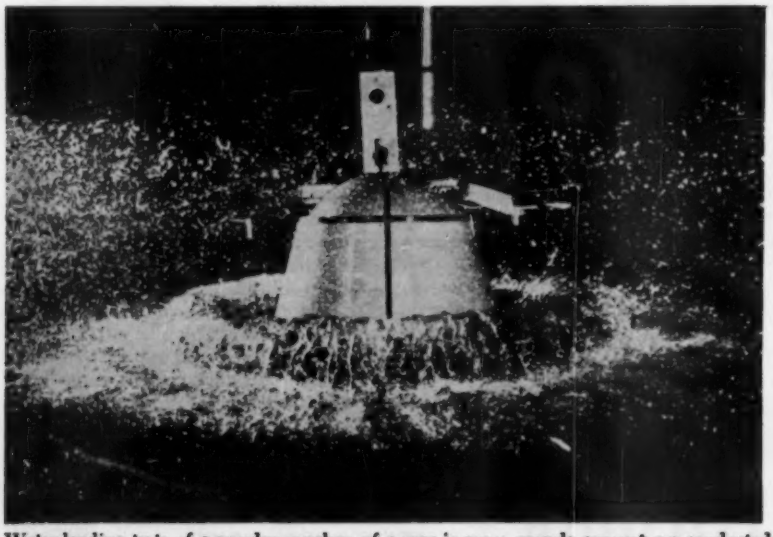
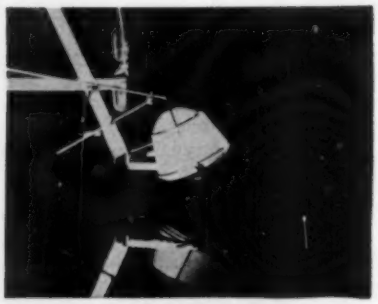
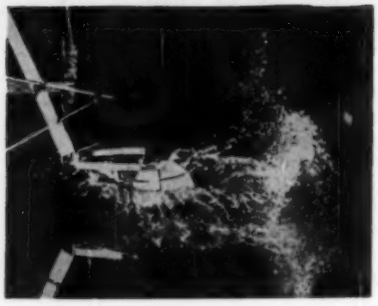
Lift, drag and static stability characteristics of this model of a manned satellite capsule are studied in the full-scale tunnel of Langley Research Center, National Aeronautics and Space Administration. Objective is to find optimum shape of the Project Mercury capsule.

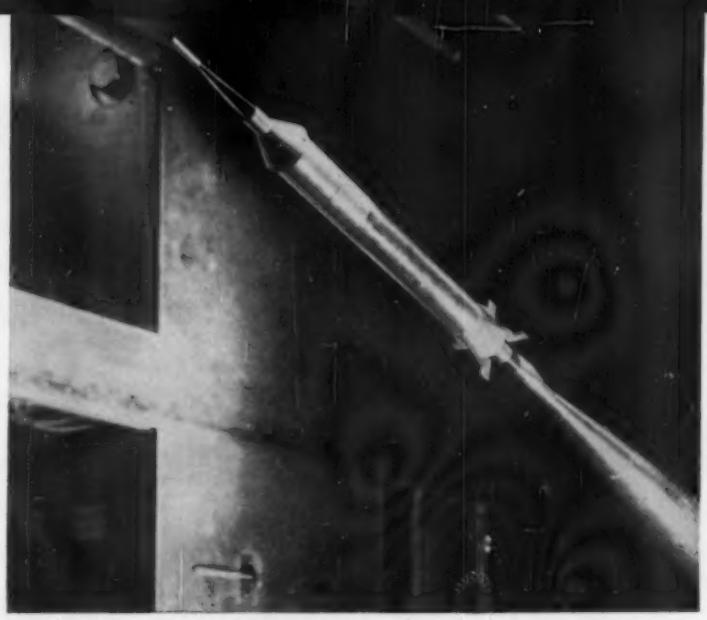
NASA Tests Models of Man-in-Space Capsule and





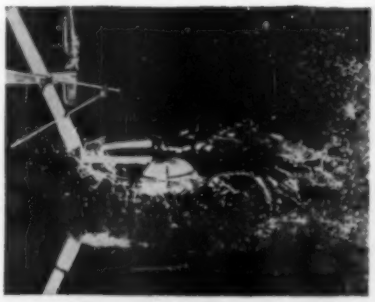


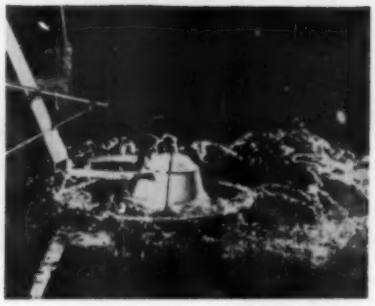
Water-landing tests of a wooden mockup of a man-in-space capsule concept are conducted at Langley Research Center. Instrumented capsule will carry a parachute and survival gear.

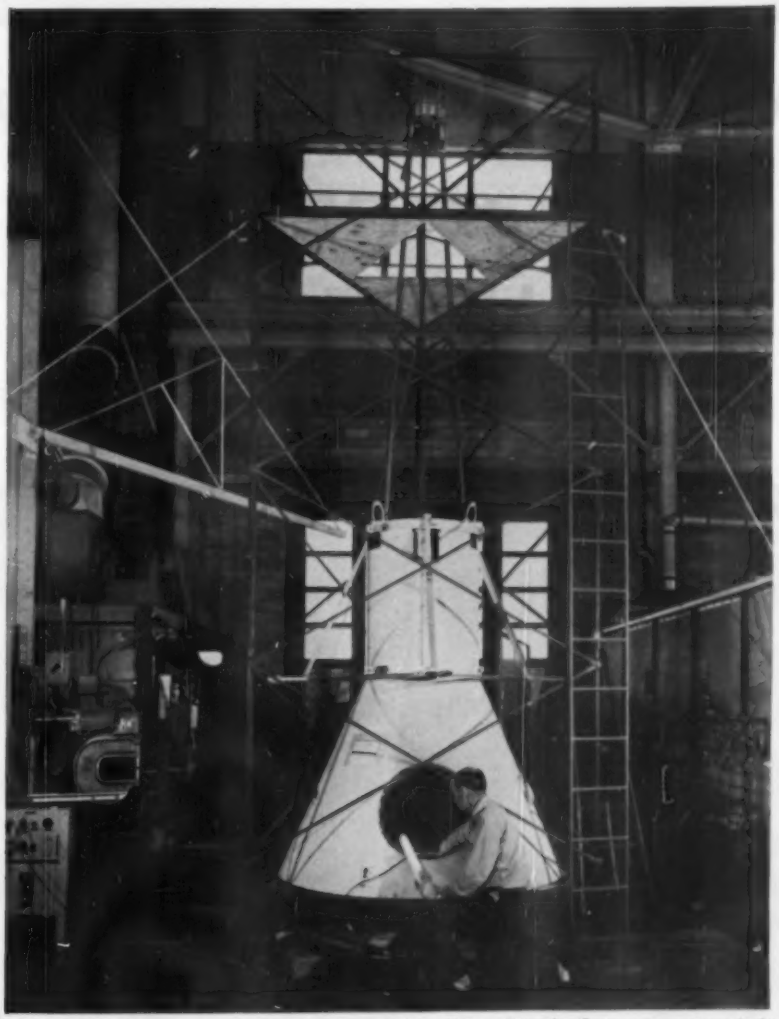


Small-scale model of a Redstone with man-in-space capsule and escape system on nose (above, left) is tested for lift, drag and static stability in the Langley Research Center eight-foot transonic wind tunnel. Model is sting-mounted. At right above the escape system and capsule alone undergo wind tunnel testing. Full-scale models are being used at the Pilotless Aircraft Research Station at Wallops Island for reliability tests of the escape system, aerodynamic studies of the capsule-escape combination, correct alignment of escape rocket nozzles and dynamic forces on the capsule and escape arrangement during launching and descent.

Escape System







This Project Mercury capsule model is the actual model used in the first escape system tests at the Pilotless Aircraft Research Station, Wallops Island, Va. (AW Mar. 30, p. 27).

Martin P6M SeaMaster employs Republic Titanium

FOR STRENGTH, HEAT-RESISTANCE, WEIGHT-SAVING

The P6M SeaMaster is being built for the Navy by The Martin Company, Baltimore, Maryland. The attack seaplane is designed for minelaying and photo-reconnaissance. Photo shows a titanium center beam used in each engine nacelle.

Two factors enabled The Martin Company to smooth the way for rapid, economical transition from design and development to production and delivery of the SeaMaster. First, was far-sighted planning on the prototype. Second, was utilization of the latest engineering principles, production concepts, and materials, including Republic Titanium.

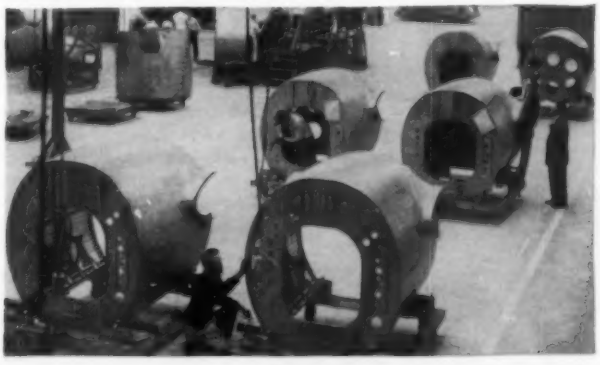
Employing commercially pure titanium and titanium alloys, the SeaMaster contains more than 500 titanium details. The largest is a formed sheet metal bulkhead measuring 30″ by 45″—probably the largest detail ever formed from titanium at the time it was produced.

Commercially pure titanium and titanium alloy types supplied by Republic are used for strength, heat-resistance, and weight-saving. The titanium alloys are among the strongest now being produced and offer high strength values at elevated temperatures. In fact, titanium alloys provide the highest strength-to-weight ratio of any construction metal.

Many types of metals are required to meet the varied requirements of both aircraft and missile manufacturers. Metals to resist heat and corrosion, to reduce weight, to add strength. Production of these flight weight metals is a Republic specialty.

Republic metallurgists and engineers are always available to work with your personnel in developing the most advantageous use of Republic Titanium, Stainless Steels, and Alloy Steels. The coupon is your invitation to use this obligation-free service.

REPUBLIC ALLOY FORGING STEELS meet designers' requirements for operating and structrual parts that must be free from excess weight, yet tough and strong to withstand shock, impact, stress, and fatigue. In these quality steels are found the highest strength values—plus an exceptionally high strength-to-weight ratio that permits the use of thinner, lighter sections to save weight and hold down size without sacrifice of strength or safety. These essential qualities were the basis for selection of Republic Hot Rolled AMS 6415 (AISI 4340) for compressor rotor discs in jet engines. The discs are machined from forgings by the Tapco Group, Thompson Ramo Wooldridge Inc. Forgings were supplied by Wyman-Gordon Company.



REPUBLIC ENDURO STAINLESS STEELS, Types 301 and 302, are used by Solar Aircraft Company in fabricating complete nacelles for Navy P2V patrol bombers. Stainless construction offers a number of advantages including less maintenance for protection against corrosion, greater strength, ability to withstand high temperatures, the use of lighter gages to save weight. These types are readily formed into desired shapes by the usual commercial methods.

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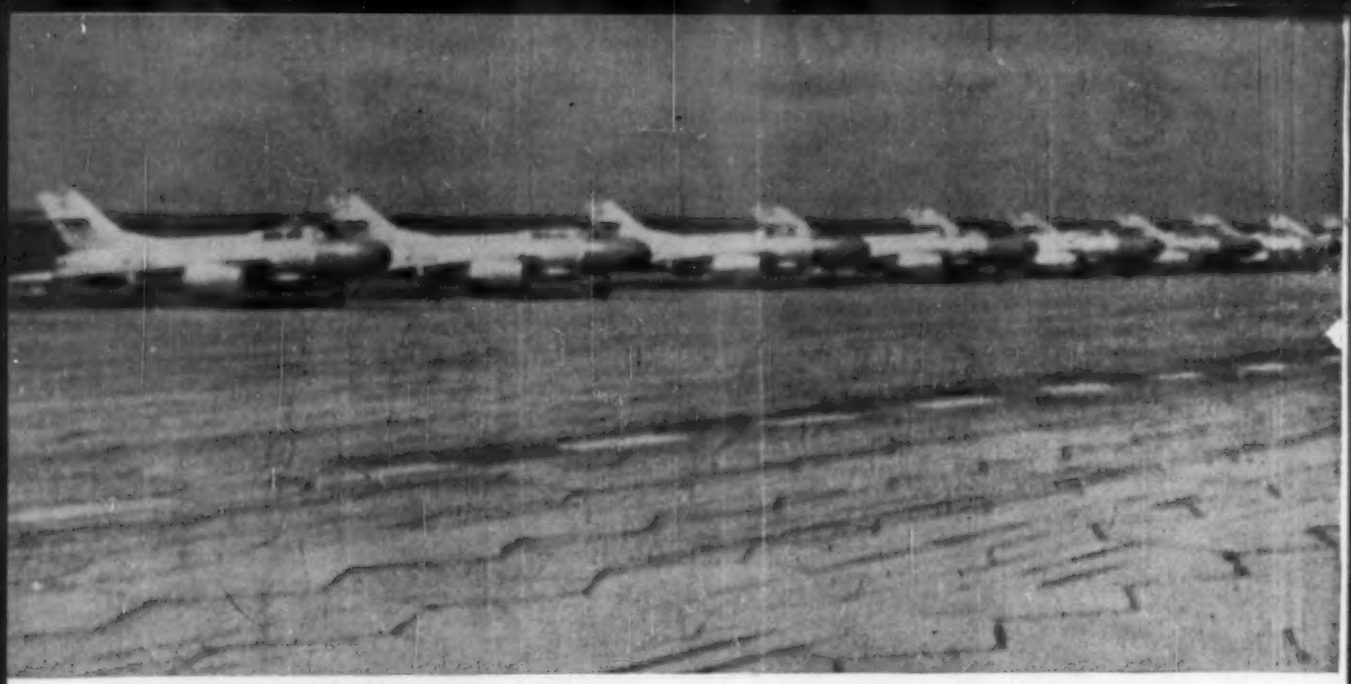
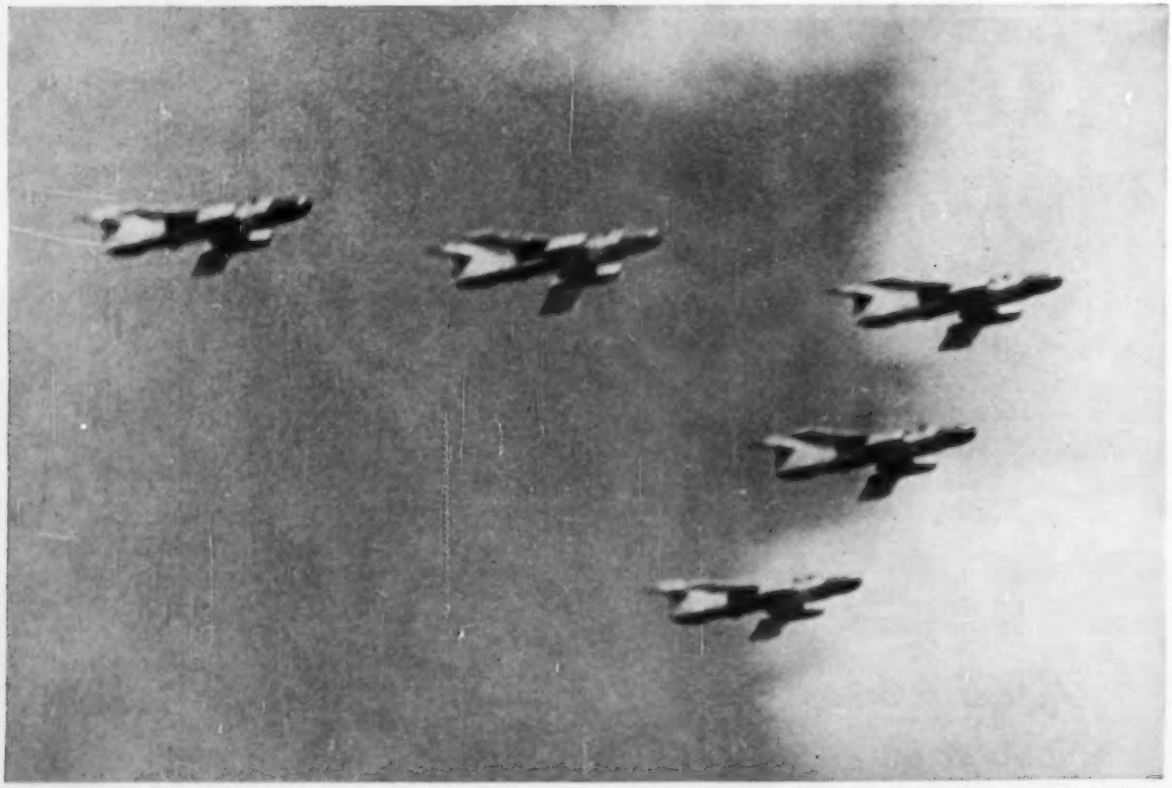
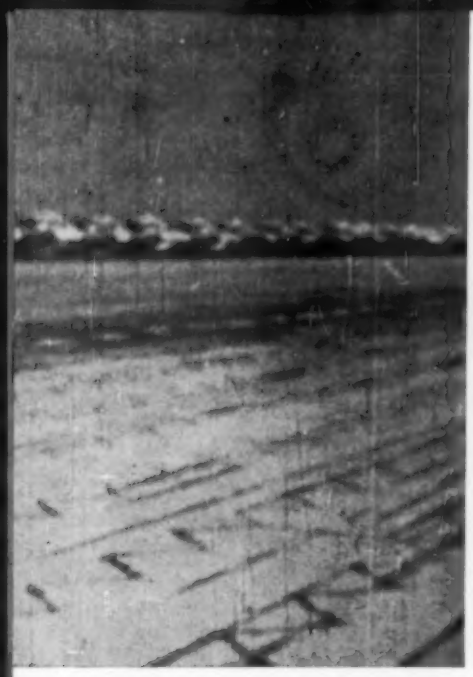


Squadron of all-weather twin-jet Yak-25 fighters (NATO code name Flashlight A) is lined up on an operational airfield in Russia. The zigzag pattern of the runway concrete is typical of older Russian airfields. Flashlight A is in the high subsonic speed range and is the standard Soviet operational all-weather fighter.

Soviet Yak-25 All-Weather Fighter Operational

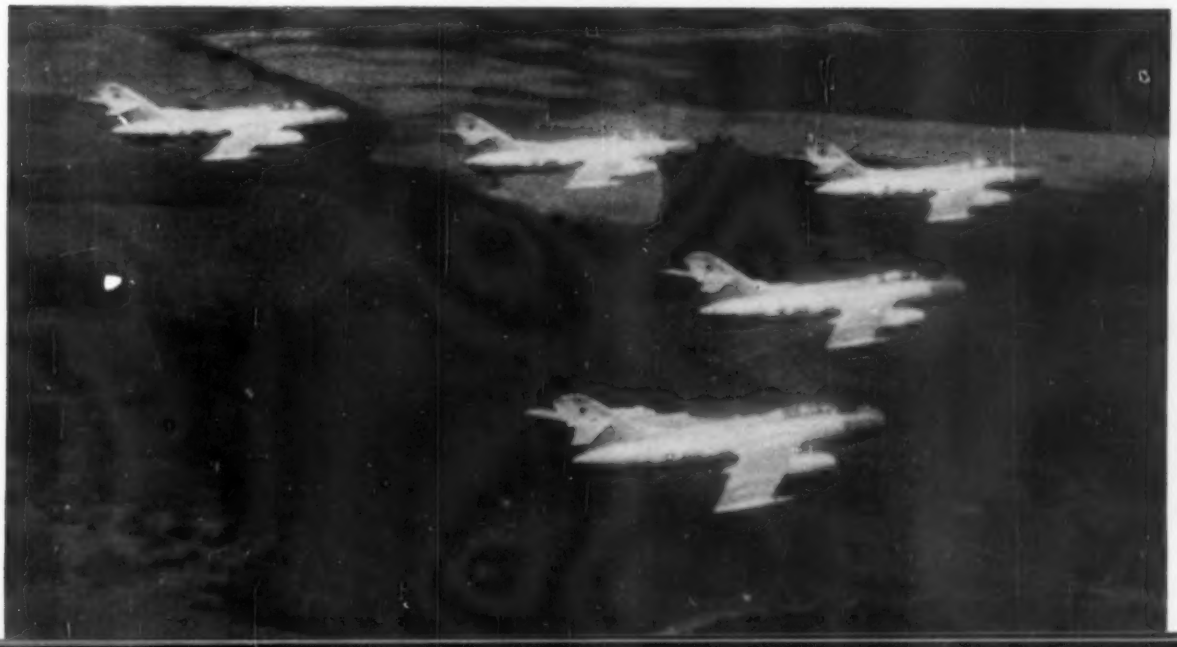


Large nose radomes and cannon installations are visible in photograph of Yak-25 formation. In addition to the cannon the Yak-25 has a retractable belly tray for firing folding-fin, unguided solid-fueled rockets. Some versions are equipped to fire air-to-air infrared guided missiles from external installations.



Yak-25 all-weather fighters scramble (above) from a Russian airfield during an operational practice. Note the high-set horizontal stabilizer similar to earlier MiG fighter designs, and faired-off fuselage rear, indicating the absence of rear-firing armament.

Air-to-air closeup of Yak-25 (right) shows tandem seating arrangement of pilot (front) and radar operator. Both are equipped with ejection seats. Radar console is visible in the rear cockpit. Slotted bulge on lower fuselage houses 37 mm. cannon with slot designed for weapon gas ejection. Relatively small diameter axial flow turbojet of about 8,000 lb. thrust is probably the same type used in the twin-jet MiG-19 (AW April 6, p. 84). Note large-diameter fuselage nose radome, indicating both wide angle and long-range search and target tracking capability. Low-level formation photo of Yak-25s (below) shows the ventral fin under the rear fuselage and two wing fences outboard of the engine nacelles. The top of the vertical fin contains a radar antenna. The supersonic successor to the Yak-25—Flashlight C—appeared in prototype form in 1956 but has not been observed in operational units.



A SALUTE TO THE WORLD'S LARGEST HELICOPTER OPERATION

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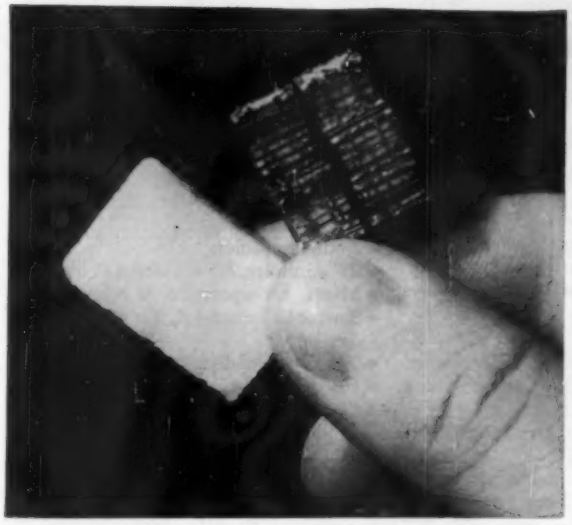
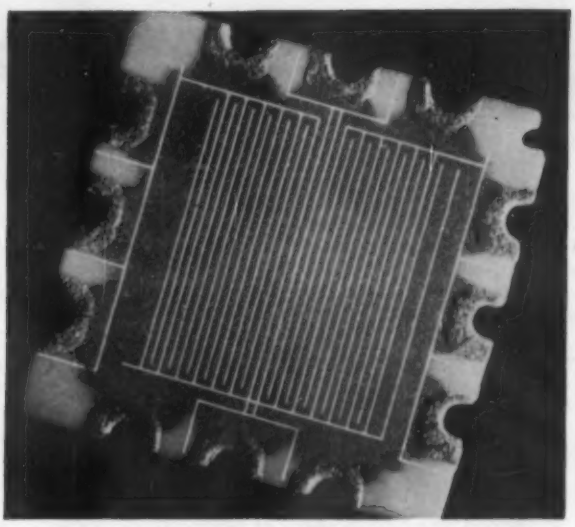




RADIO receiver, at left, built from new RCA Micro-Module elements, achieves component densities approaching 600,000 per cubic foot. RCA says it can soon supply 15 different Micro-Module circuits. Resistor made from semiconductor material is at right.

New Techniques Shrink Avionics Size

By Philip J. Klass

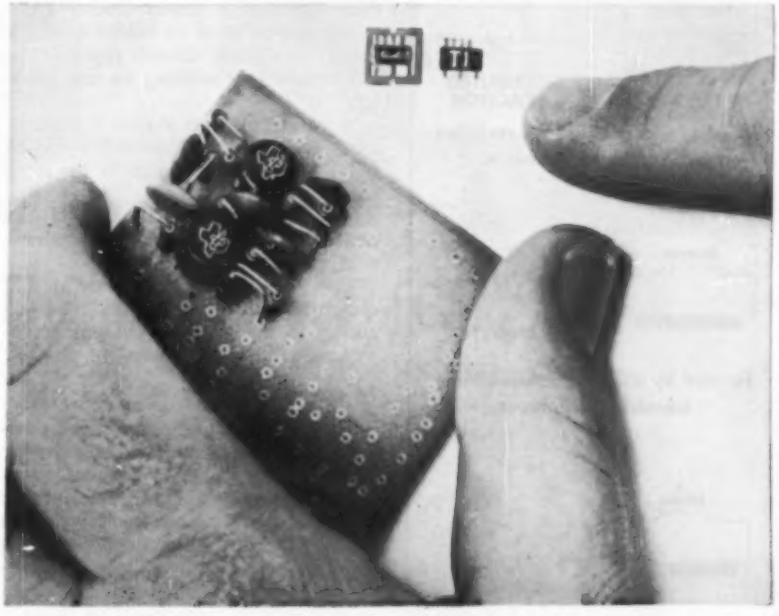
New York—Significant new developments in micro-miniaturization and solid-state circuitry which promise 10 to 100-fold reductions in the size and weight of avionic equipment were revealed here during the recent national convention of the Institute of Radio Engineers.

• **Texas Instruments** demonstrated solid-state circuitry in the form of a tiny multivibrator and phase shift oscillator, each fabricated from a single crystal of silicon, which may permit the equivalent of component packaging densities of 25 million parts per cubic foot. Figures of roughly 50,000 per cubic foot are obtainable using today's best sub-miniaturization techniques and components (AW Mar. 30, p. 330).

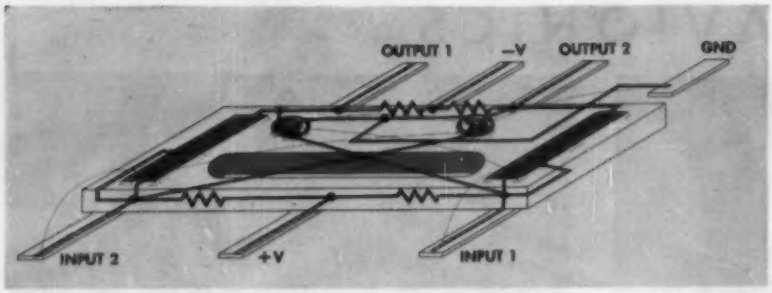
• **Radio Corporation of America** reported that its Army sponsored Micro-Module program, not yet a year old, has advanced to a point where one company soon can provide 15 different functional circuits in Micro-Module form in sample quantities for use by defense electronic equipment producers. RCA says Micro-Modules should permit component densities of up to 600,000 parts per cubic foot.

• Servomechanism's David W. Moore said that it may soon be possible to use thin films of evaporated nickel iron to perform most of the logic and memory functions of a digital computer, opening the way to a major size and weight reduction. The prediction is based upon newly discovered magnetic domain reactions in evaporated nickel iron films. Company work on evaporative deposition techniques, under Office of Naval Research sponsorship, was first reported by AVIATION WEEK (Sept. 30, 1957, p. 70.)

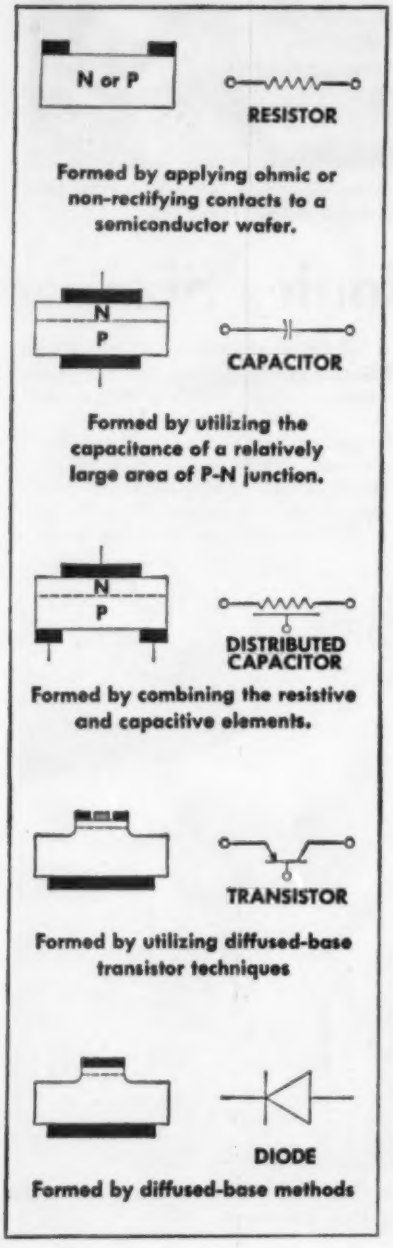
• **Air Research & Development** Command's Col. C. H. Lewis demonstrated a solid-state light-modulated multivibrator, developed by Westinghouse Electric Corp., which occupies only 0.001 cu. in., weighs only 0.02 gr., and consists of a single semiconductor element with only two soldered junctions. Lewis said that Air Force is now negotiating with industry for major program to demonstrate feasibility of solid-



TINY computer flip-flop (top center) produced from a single silicon crystal is one of the micro-miniature solid-state circuits developed by Texas Instruments, Inc.



TOPOGRAPHY of new solid-state semiconductor circuit flip-flop, and corresponding schematic diagram, are shown above. Different circuit functions, which can be achieved using semiconductor materials, are shown below. To date, semiconductor equivalent of an inductor has not been found.



state circuitry, or molecular electronics as it prefers to call it.

Texas Instruments makes use of the resistivity semiconductor materials, and the capacitance effective of a large-area P-N junction to fabricate complete circuits including transistor and diode functions in a single semiconductor crystal.

Controlled Masking

Using controlled masking, etching and diffusion processes, Texas Instruments has come up with a tiny multivibrator which measures only $\frac{1}{4} \times \frac{1}{8} \times \frac{1}{32}$ in., performing function that normally would require two separate transistors, eight resistors and two capacitors. A phase-shift oscillator, which ordinarily would use one transistor, five resistors and three capacitors, has been fabricated on single crystal of approximately the same dimensions.

Company has not yet been able to come up with a semiconductor functional equivalent of an inductor, which limits immediate circuit applications, but reports it is working on this problem.

Texas Instruments already is working with several computer manufacturers to develop solid-state circuitry to meet their specific needs.

Spokesman predicts the use of the new elements in developmental systems within a year.

Company says it can provide sample quantities of its existing solid-state circuits, for evaluation by equipment designers, within several months.

Micro-Modules

Radio Corporation of America's progress and the extent of supporting activity by established component manufacturers surprised many observers at the IRE convention. In less than a year, RCA and its program associates have come up with a range of functional circuits in Micro-Module form as well as basic components on thin 0.3 in. square wafers which are the building blocks from which the Micro-Module is actually fabricated. RCA says it will be able to supply engineering samples during the second half of this year of the following functional circuits in Micro-Module form for evaluation by defense electronic equipment manufacturers:

- **Binary divider.**
- **Gate.**
- **Intermediate frequency amplifier,** for operation at 4.3 mc.
- **Limiter,** for operation at 4.3 mc.
- **Discriminator.**
- **Audio amplifier.**
- **RF amplifier,** for operation at 49.4 mc.
- **Mixer,** for operation at 4.3 mc.
- **Sawtooth generator,** for operation at 8 kc.
- **Time modulator.**
- **Oscillator,** for operation at 192 kc.
- **Clipper.**
- **Pulse shaper.**
- **Output amplifier.**
- **Pulse generator.**

The Micro-Modules which RCA has constructed to date were designed for use in a Micro-Module version of the Army's AN/PRC-36 radio set, AN/TCC-26 time division multiplex equipment, and AN/TSQ-8 coordinate data set, rather than being designed as general purpose circuits for wide industry application.

Micro-Module Components

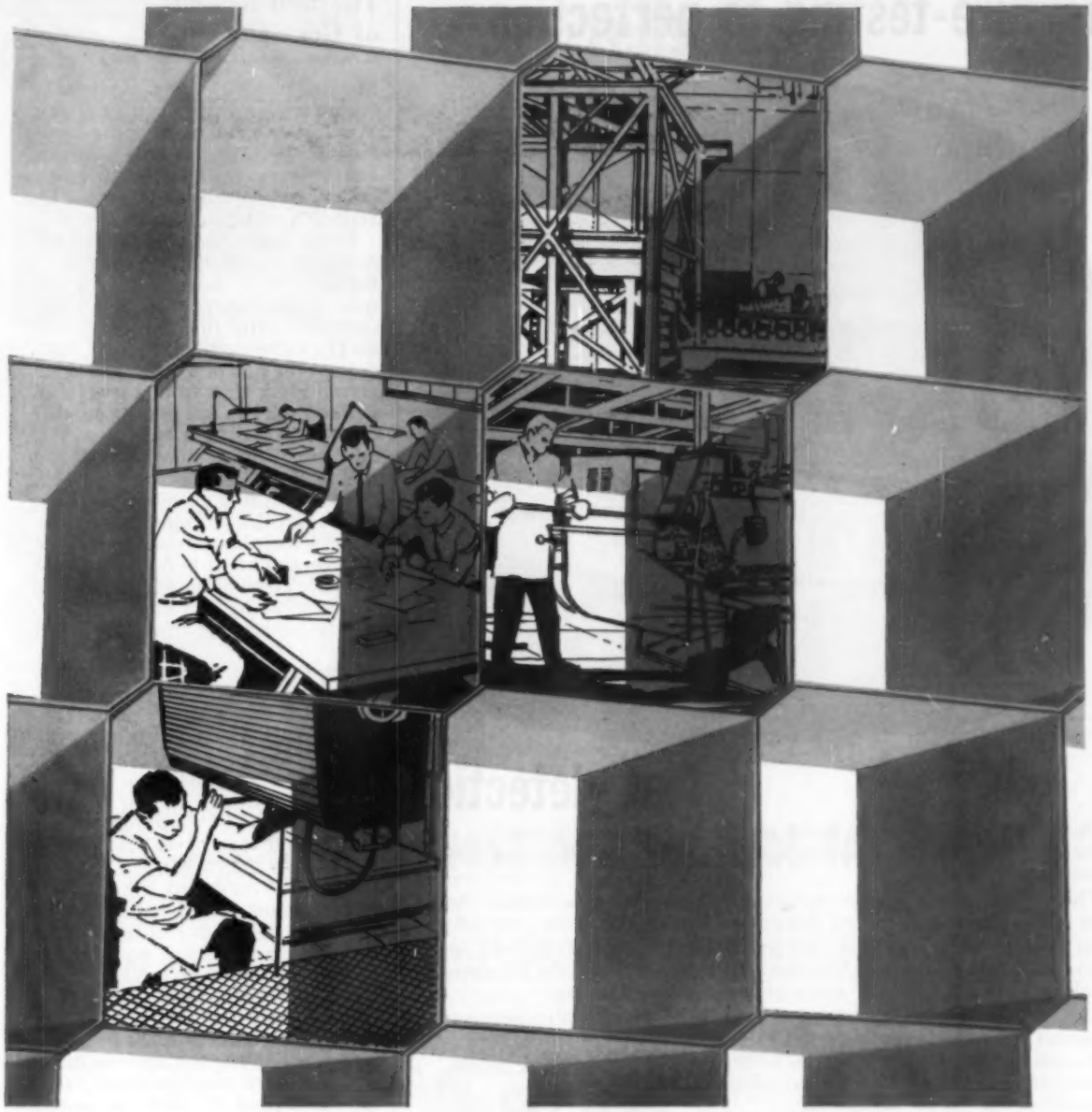
More than 20 component manufacturers have submitted sample components in the new wafer form factor, called Micro Elements for RCA's evaluation.

These include:

- **Resistors:** Allen-Bradley, Centralab, Chicago Telephone Supply, Corning Glass, Daven, Daystrom-Weston, Glass Products, and Mallory.
- **Capacitors:** Aerovox, Magnavox, Mallory, and Sprague Electric.
- **Inductors:** ARF Products and RCA-Needham.
- **Transistors:** Philco and RCA-Somerville.
- **Diodes:** General Instruments, Hoffman Semiconductor, Pacific Semiconductor.
- **Crystals:** Midland Manufacturing.

Range of component types and values which are currently available, according to data released by RCA, is as follows:

- **Resistors:** Deposited thin film, 22 ohms to 100,000 ohms, $\frac{1}{4}$ watt, with temperature coefficient less than 200 ppm/C. Also, metal oxide film resistors, 22 ohms to 180,000 ohms, also with temperature coefficient less than 200 ppm/C.
- **Capacitors:** General purpose thin film ceramic, single layer with values up to 5,000 mmfd. at 100 v.; multiple layer, up to 0.3 mmfd. at 50 v. Precision thin film ceramic, single layer, up to 39 mmfd. at 100 v.; multiple layer up



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The Red Knight of Germany

(Continued from Inside Back Cover)

Manfred von Richthofen, destined to become Germany's greatest ace of World War I and leader of the Royal Prussian *Jagdstaffel* 11, infamous as a hunting pack. In time, British troops came to call the men and planes of his *Staffel* "Richthofen's Flying Circus."

Von Richthofen scored his first kill in the air on the morning of September 17, 1916, by shooting down a two-seater British fighter plane behind the Germans' third line. He celebrated his first victory with champagne, then ordered the first of a collection of engraved silver cups from a jeweler in Berlin. Each cup was to mark another victory. In less than two years, this calculating airman scored 80 kills and 126 unofficial victories.

The German ace flew by the book, not by instinct. A former cavalry officer, von Richthofen transferred to the German air force to be nearer the front lines. He failed his first solo flight and later cracked up two single-seat Fokkers before being assigned as a fighter pilot.

Von Richthofen's fame grew fast in the autumn of 1916 — the most glorious period in the history of the German air force. In the first half of 1917, Allied air losses were four times greater than those of Germany. In "Bloody April," 368 British aircraft were destroyed. Most of these losses were attributed to the Fokker Triplane, designed by a Dutch neutral, Anthony Fokker. Fokker's bank-winged Dr.-1 triplane compensated for its lack of speed through high maneuverability. It could climb quickly, turn sharply, and perform stunts in combat.

The first day Germany's Red Knight flew a Fokker Dr.-1 he shot down a British plane with only 20 rounds of ammunition. The last day von Richthofen flew a Fokker Dr.-1 was a chill Sunday — April 21, 1918. As he and other pilots of the Flying Circus pre-

GERMANY'S RED BARON
...a champagne toast and silver cups

(*Advertisement*)

pared for the morning flight, a mechanic asked him to pose for a picture. Not since the famous German ace Oswald Boelcke had been photographed just before his last flight would a German pilot permit his picture to be taken before going to combat. But von Richthofen couldn't abide superstition. He posed for the picture, stepped into his flaming-red Fokker Triplane and took off.

During a dogfight over the Somme River, a single bullet penetrated his chest. The Red Knight of Germany was dead when his plane landed safely beyond the trench positions of an Australian field battery near the Somme. The victory was credited to Captain A. Roy Brown, D.S.C., a 24-year-old Canadian flier on patrol duty.

Gone forever from the skies was the German who had shot down 30 planes in a 30-day period during the spring of 1918. At home, his mother prized a collection of 80 cups. Seventy-seven were silver, and the last three were made of lead.

There was no silver left in Berlin.

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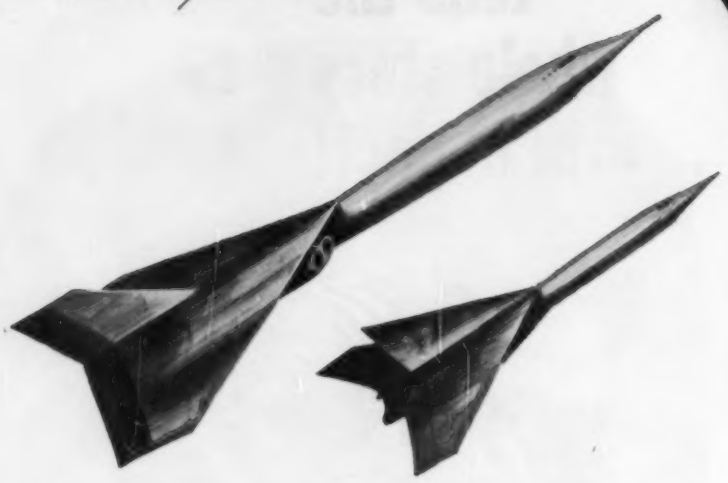

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• **Inductors:** Temperature-compensated ferrite core, 4.3 mc. to 50 mc., up to 1½ millihenries with "Q" greater than 100.

• **Diodes:** Type 1N277 high current, gold bonded. Type 1N643 silicon, fast-switching, a Zener reference, and a voltage-sensitive variable capacitance type.

• **Transistors:** Type 2N140, general purpose audio amplifier. Type 2N404, switching device. Type 2N384 VHF small signal amplifier, with 15 db. gain to 50 mc. Also a VHF small signal amplifier with 20 db. gain at 70 mc., and a VHF power amplifier for operation up to 70 mc.

• **Crystals:** Three quartz crystals are available for operation at 7 mc., 45.1 mc. and 70 mc.

• **Multi-elements:** These include a multi-resistor wafer, consisting of four resistors rated ⅛ watt each, with temperature coefficient less than 200 ppm/C, an R-C combination of ceramic capacitor and deposited thin-film resistor, and an L-C combination of ferrite core inductor and ceramic capacitor. Multi-element resistors, with values of 10 ohms to one megohm, are being produced by Daystrom-Weston using wafer coated with semiconductor material on which are inscribed isolation lines which provide desired resistance. Resistance value range can be extended by using multi-layer elements, company says.

• **Batteries:** Mallory says it has developed a mercury battery, measuring only 0.305 in. in diameter and 0.135 in. thick for use as a self-contained power source in Micro-Modules. Company also is developing variable potentiometers, ceramic capacitors and resistors for the Micro-Module program.

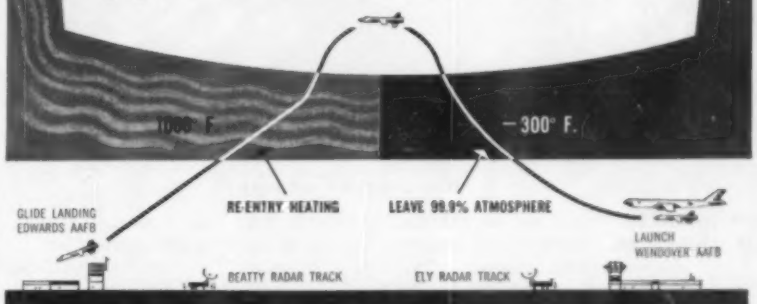
Mechanized Assembly

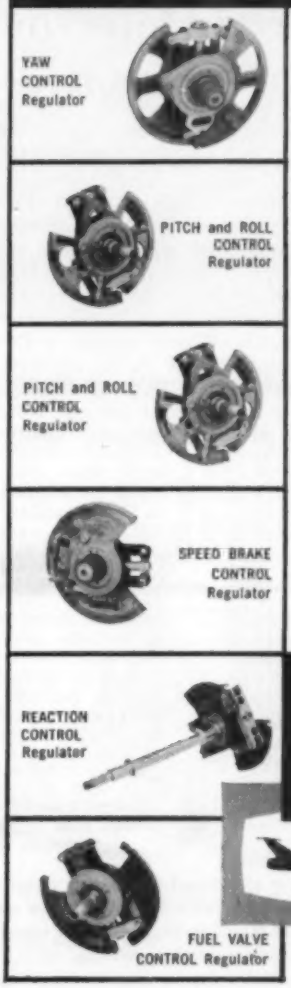
RCA says it is developing techniques for mechanized machine assembly of the individual wafer components into complete modules. At present, this is accomplished by hand using special jigs. Wafers are interconnected by means of wires along wafer periphery which also provide structural support, much like technique employed for earlier Navy Project Tinkertoy modules, developed by the National Bureau of Standards.

RCA says that 33 companies have indicated an interest in applying new Micro-Modules to their equipment. Seven of this number are major aircraft-missile manufacturers and 15 are large electronic manufacturers, RCA says.

The Micro-Module program is sponsored by Army Signal Corps and is being directed by its Research & Development Laboratory at Ft. Monmouth, N.J.

SIX Pacific
CABLE TENSION REGULATORS
fly with the X-15 into space




YAW CONTROL Regulator
PITCH and ROLL CONTROL Regulator
PITCH and ROLL CONTROL Regulator
SPEED BRAKE CONTROL Regulator
REACTION CONTROL Regulator
FUEL VALVE CONTROL Regulator

HYPERSONIC SPEEDS THAT CAUSE SURFACE HEATS IN EXCESS OF 1000°F. IN SECONDS . . . AND LOX TEMPERATURES THAT DROP METALS TO LOWS OF −300°F. CREATE A SERIES OF DIFFERENTIAL EXPANSION PROBLEMS ON THE CABLE CONTROL SYSTEMS OF NORTH AMERICAN'S X-15!

To solve this problem six Pacific cable tension regulators were installed on the Speed brake, Reaction, Fuel select, Pitch, Roll and Yaw control systems.

These mechanical devices automatically and positively compensate for variations in the cable systems—as swiftly as changes occur. All control cables are kept at an even tension insuring constant control response.

Pacific regulators also permit rigging cables at a lower load, thus increasing control sensitivity. They are self-contained mechanical devices with a high degree reliability—and without dependence upon any external power source.

Pacific regulators are capable of instant compensation for thermal or mechanical variations.

For further information on Cable Control Systems—*write Pacific Scientific today!*

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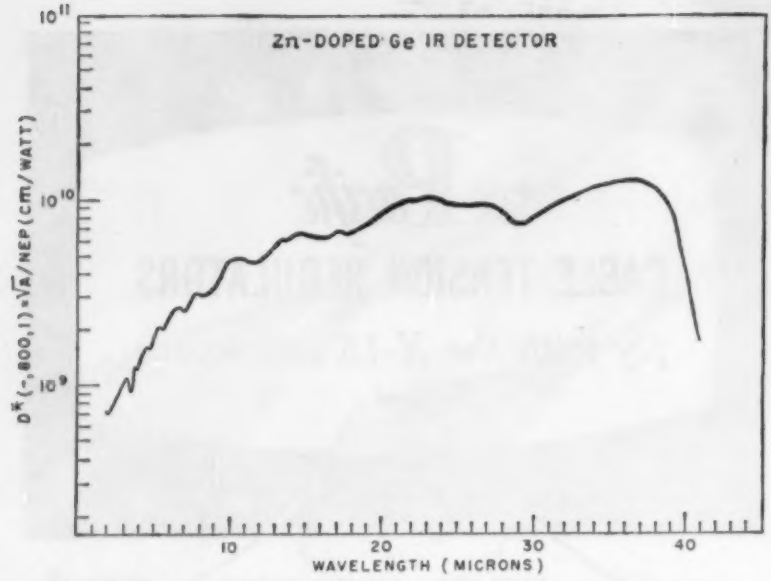


NEW INFRARED detector exhibits wide spectral response, from 2 to 40 microns, as well as high sensitivity and extremely rapid frequency response of less than 0.01 microsecond.

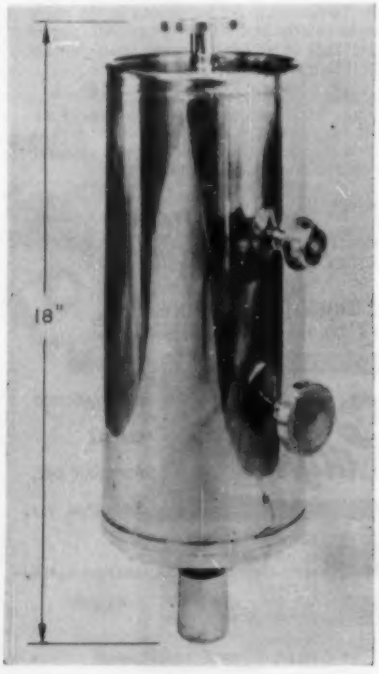
Photoconductor Infrared Detector Exhibits Wide Spectral Response

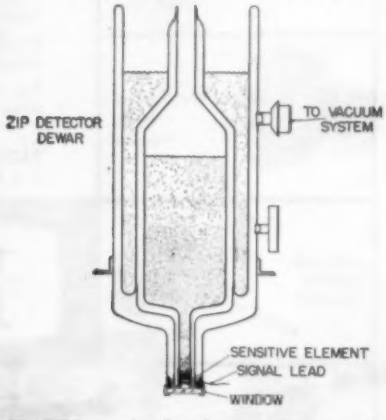
New infrared detector, a photoconductor type which is sensitive from 2 to 40 microns and has a response time of less than 0.01 microsecond, permitting improved performance of infrared detection and surveillance systems against relatively cool targets, has been announced by Perkin-Elmer Corp., Norwalk, Conn. Device now is in production.

New Model 536-1 ZIP detector, short for Zinc-Impurity Photoconductor, was developed originally by Naval Research Laboratories. When the zinc-doped germanium detector is cooled to temperature of liquid helium (approximately 4K), it exhibits a D* factor (sensitivity) of 4×10^{9} cm/watt for radiation from a 500K black body, chopped at frequency of 800 cps. with a 1 cps. passband, company reports. (The D* factor, equal to the square root of the area of the detector, divided by its noise-equivalent-power, is technique used to define detector sensitivity so that it is independent of cell size.)

New infrared cell is mounted in a double Dewar flask type cryostat for cooling. Inner flask contains liquid helium which in turn is cooled by outer flask containing liquid nitrogen.

Over-all cryostat dimensions are 6 in. in diameter, 18 in. long. Detector is located in a small snout which extends from the base. New detector is available with cell measuring 2 x 2 mm., or with other dimensions up to approximately 20 mm. Detector impedance is 300,000 ohms.





IR CELL, a zinc-doped germanium crystal, is mounted in a double Dewar flask type of cryostat and cooled to temperature of liquid helium to achieve high sensitivity.

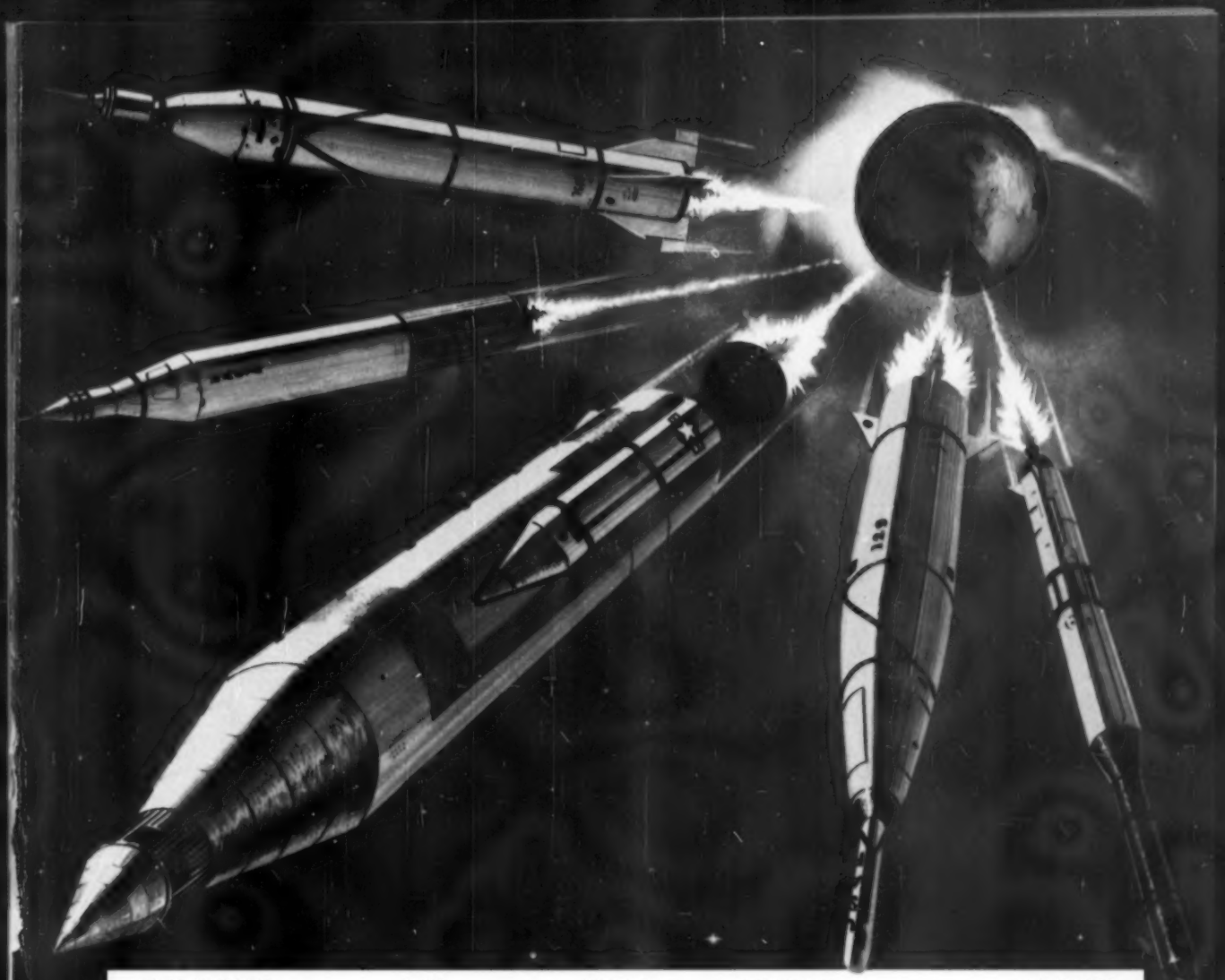
FILTER CENTER

▶**Parametric Computer Elements**—Parametric amplifiers, which show promise as extremely low-noise microwave amplifiers, may also find application as computer flip-flop elements, permitting major increase in speed of digital computers, according to Dr. C. L. Hogan of Motorola.

▶**Emphasis On Thermo-Electricity**—Approximately 30 industrial, government and university laboratories are now actively investigating new techniques and materials for direct conversion of heat into electric power, according to General Electric's Dr. W. J. Van der Grinten. Problem of obtaining secondary power for space vehicles and satellites has done much to stimulate current widespread interest in a basic technique which is more than a hundred years old.

▶**Bats In Harvard's Belfry**—Harvard University scientists are investigating techniques used by bats to extract useful information from their sonar despite human attempts to "jam" them. Behind the investigation is the idea that nature may provide useful ideas for designing radar to withstand electronic countermeasures, according to Rear Adm. Rawson Bennett, chief of Office of Naval Research. Adm. Bennett reports that Lincoln Laboratories is providing engineering support for the investigation.

▶**Parts Specifications Study**—Defense Department-industry group working out a new program to improve reliability of electronic components, better monitoring of vendor quality and useful techniques for specifying component reliability for equipment designers is expected to complete its study by late summer. Paul Darnell of Bell Telephone Laboratories heads the group.



ATLAS-IN-ORBIT JUNO JUPITER C THOR ABLE VANGUARD

1 MISSILES-IN-SPACE

. . . Man's imagination rides aboard these vehicles. They range out into the void — out where there is no atmosphere, no sound, no trail, no landmark and no predecessor. The spacecraft are the test vehicles for the military space fleets of tomorrow — and the signposts in the sky for all the nations in the world to follow. Spacecraft are symbols of man's hope, too. Descended from the missiles of war, they are truly swords beaten into plowshares. In the words of one of Aviation's leading spokesmen, James S. McDonnell, president of McDonnell Aircraft Corporation: "The rivalry for space exploration . . . is the creative substitute for war."

Specialized functional fluids from Monsanto are helping in the design of spacecraft, missiles, and manned aircraft for deep penetrations into space.

Monsanto chemistry has created synthetic fluids with special properties — fire resistance, thermal stability, radiation resistance — chemically stable lubricants, heat and power transfer fluids and dielectric coolants that have made possible new concepts in system designs, new performance peaks for space vehicles of all types. Monsanto has pioneered the chemistry of these fluids . . . and today has more than 20 functional fluids with special uses . . . many more base stocks that can be modified to solve space engineering problems.

Skydrol* and Skydrol 500 fire-resistant aircraft hydraulic fluids . . . the standard for hydraulic fire safety. Coolanol* 45 coolant-dielectric hydraulic fluid . . . for reliable, uniform electronic cooling. Santowax*, biphenyl and isopropylbiphenyl . . . thermally stable and radiation-resistant fluids for nuclear reactor moderating and heat transfer. OS-45* Type IV high-temperature hydraulic fluid . . . specially designed for aircraft and missiles. Monsanto continues the chemical exploration for special fluids to create new and better fluids with properties designed to boost performance of present systems and make possible entirely new design concepts.

For a summary of the general properties of 20 Monsanto fluids, write for the descriptive folder: "Fluids . . . for specialized engineering."

Monsanto

MONSANTO CHEMICAL COMPANY

Aviation Fluids Dept. 1, 800 North Lindbergh Boulevard, St. Louis 66, Missouri

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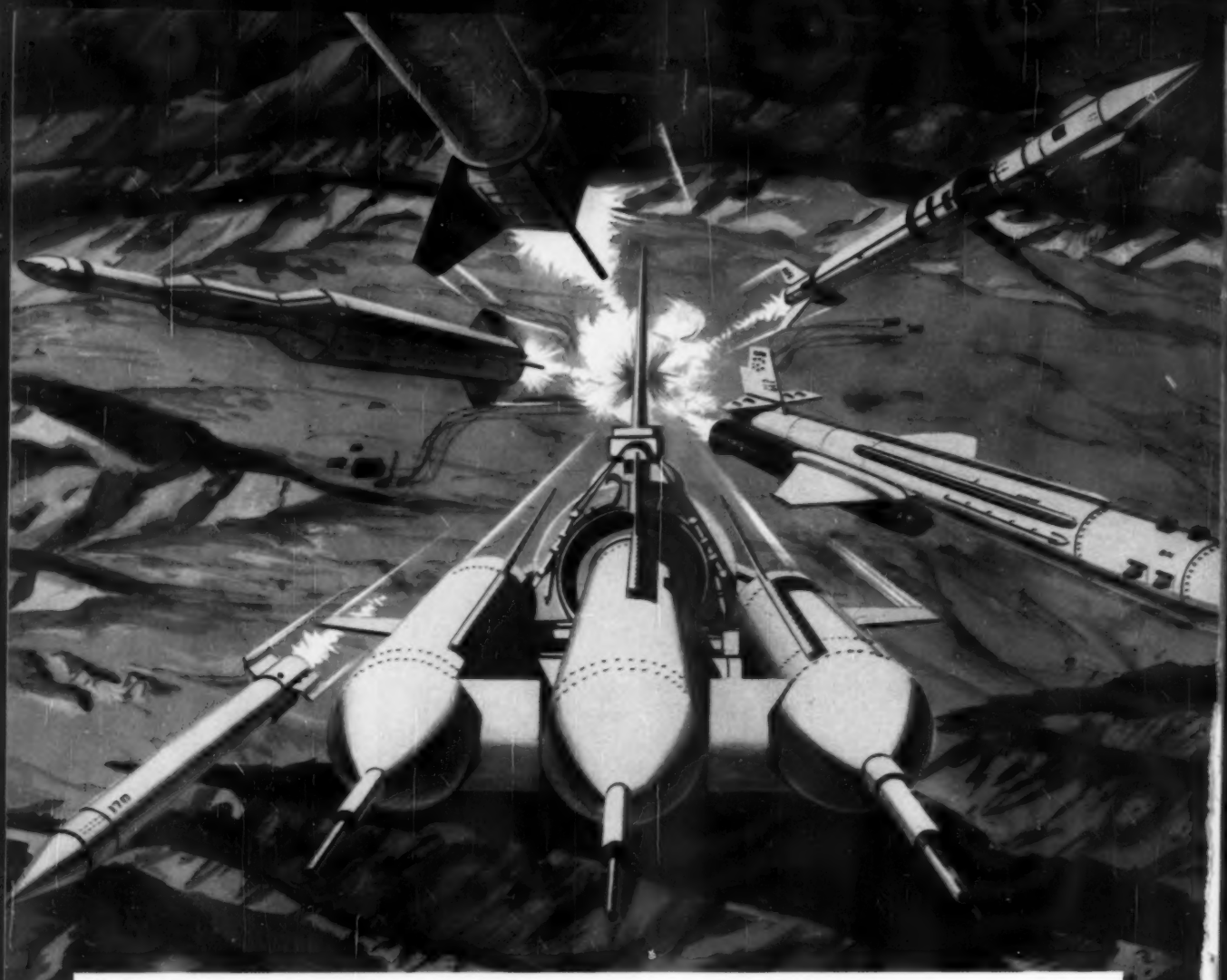


RADIOSONDE X-17 WALLOPS ISLAND ROCKET CREE SPAEROBEE X-7

2 TEST AND RESEARCH MISSILES

Ideas are the payload aboard these vehicles. In the wake of each test and research missile, concepts grow to maturity, or become stepping stones to improved ones. After the scientists formulate a new missile nose cone shape, for instance, it is up to the X-17 re-entry test vehicle to prove it out. After the latest ramjet has spent its fury against the shackles of a test cell, it takes to the skies in a test craft like the X-7. New parachute designs are put to the test in the *Cree* — must perform at 3 to 4 times the speed of sound. Complementing the test vehicles are the research craft — one kind of missile testing ideas and products, the other gathering information for new ones.

In missiles, as in other complex electronic systems, *electrical connectors are the most critical links.* Only the solderless compression method of electrical connection has been able to provide the integrity and design flexibility required for such units. Burndy, first to apply compression to electrical connections generally, over 25 years ago, is thus uniquely prepared for current development problems. Our design groups are constantly working with industry's project engineers on a systems approach to integrate connectors with the other vital components of the system.

From prototype, thru pilot run to production line—billions of connections depend on

BURNDY

OMATON DIVISION Norwalk, Connect. Toronto, Canada
In Europe: Antwerp, Belgium

TITAN JUPITER SERGEANT ATLAS POLARIS THOR

3 BALLISTIC MISSILES

Thor — Jupiter — Atlas — Titan . . . there is a rumble of distant thunder in these names. To a potential aggressor, these missiles sound an unforgettable warning. Their message: a World War can no longer be considered "an extension of diplomacy." Crime, as a national policy, does not pay. Until a missile defense is devised, sometime in the future, the ballistic missiles are about as absolute as a weapon can get: unstoppable warheads of unbelievable destructiveness. Fired in anger, they can touch off the funeral pyre of a civilization — unused, they are a powerful force for enduring peace.

Eastern Industries helps step up the performance of aircraft, missiles and spacecraft by designing and building components and subsystems for new speeds and new ceilings. High-speed *gear pumps* and *hydraulic power units* by Eastern are smaller, lighter, more efficient for applications where every ounce makes a big difference. Eastern *avionic cooling components and systems* keep the electronic minds of missiles alert and alive despite scorching heat and sizzling speeds. Eastern designs and builds *refrigeration cooling systems* to safeguard the "black boxes" beyond altitudes where the air is too thin to act as a cooling agent. *Pressurization* and *dehydration packs* by Eastern provide near-normal atmosphere for missiles systems plunged into unearthly environments; Eastern *servo-systems — servo valves, amplifiers, fuel controls* and *actuators* — provide brain and brawn in many advanced missile systems. Each Eastern product is designed around this basic concept: to bring higher, more reliable performances to the missiles and manned aircraft headed for the skyways of tomorrow.

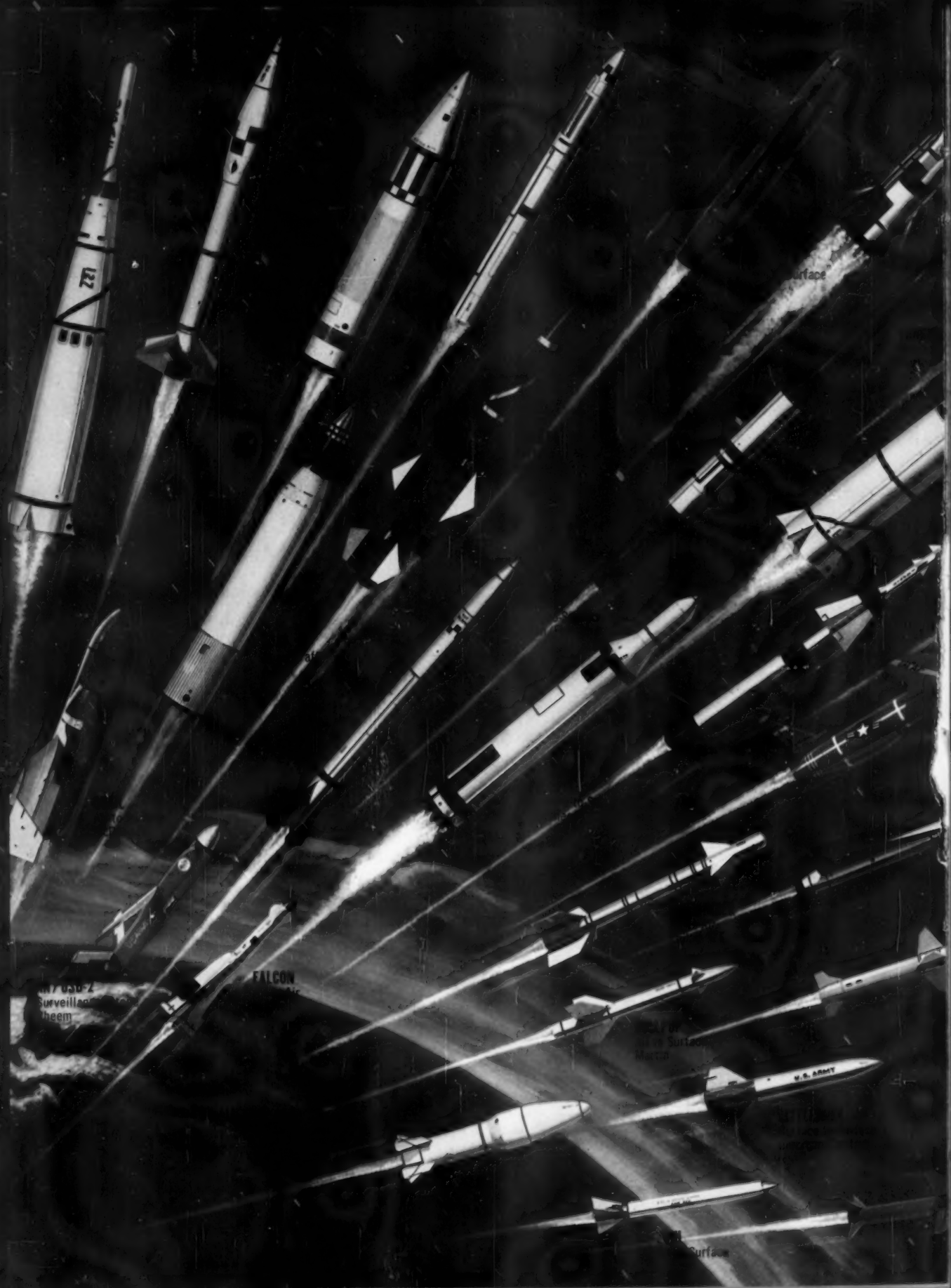
Write for catalog 360, new brochure covering the entire range of Eastern aviation products.

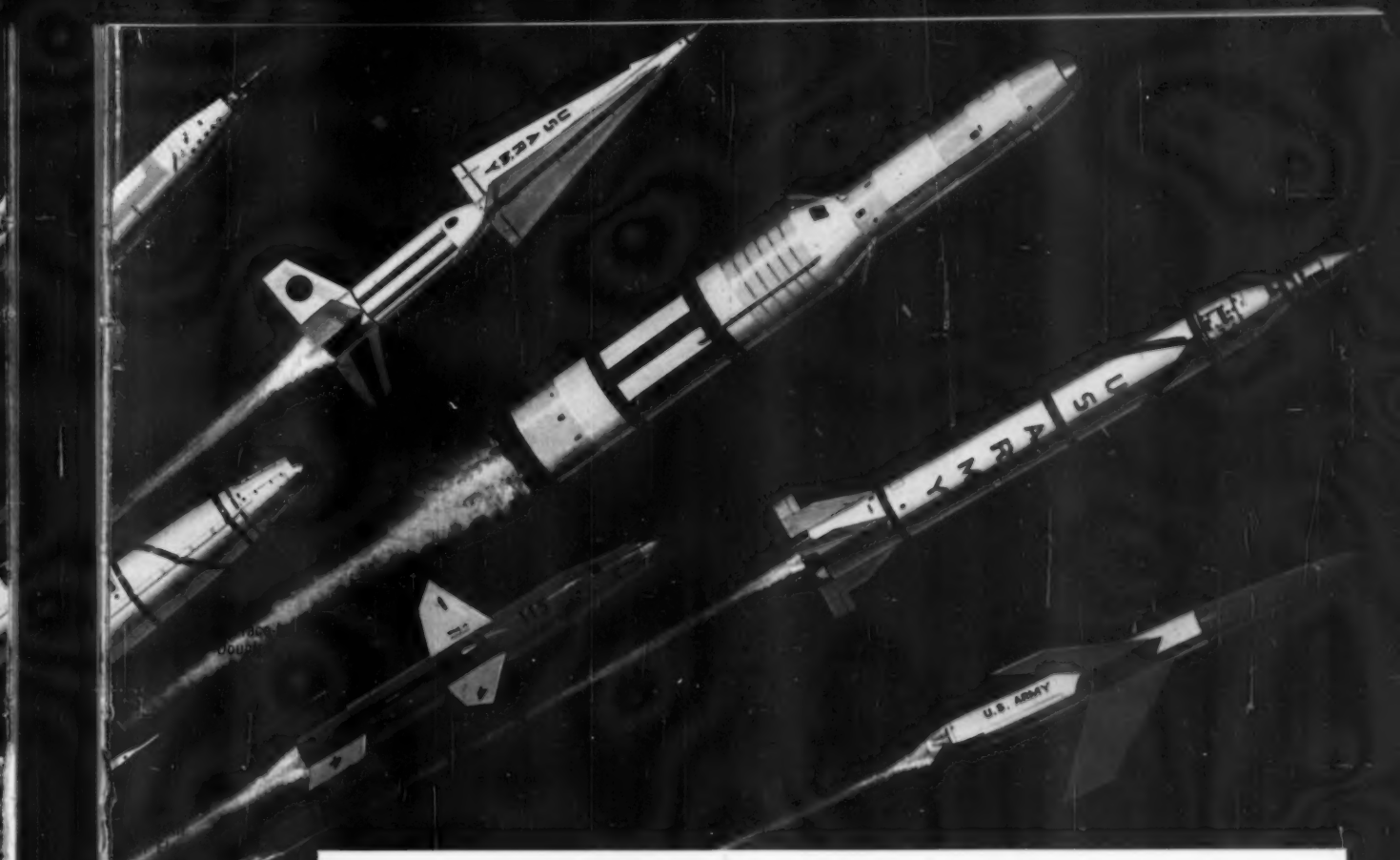
EASTERN INDUSTRIES, INC.

100 SKIFF STREET, HAMDEN 14, CONN.

West Coast Branch Office: **1608 Centinela Ave., Inglewood 3, Calif.**

Engineers: look to Eastern for challenging assignments in missile components and systems.


FALCON
U.S. ARMY



MISSILES: 1959

Rising to meet the sky, these are the guardians of our civilization: the leading missiles and spacecraft of the United States. Their numbers, their performance, their defensive, deterrent, or symbolic power protect our lives and our way of life.

The companies listed below are important contributors to the great national missile effort. Each one is proud of its specialized capabilities — and deeply aware that they represent but a small part of an immeasurable whole.

BURNDY *Omaton Division*
Norwalk, Connect. Toronto, Canada
In Europe: Antwerp, Belgium
Electrical solderless compression connectors, panels, and terminal blocks for missile and electronic applications. Installation tooling — hand, semi- and full-automatic.
Billions of connections depend on Burndy

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THE TORRINGTON COMPANY
Torrington, Connecticut — and South Bend 21, Indiana
***Research for progress in bearing design and performance . . .* Torrington's continuing research to improve design, material and performance, has developed many bearings for highly specialized aircraft and missile applications.**

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QUAIL MACE SNARK BOMARC FIREBEE TALOS AN/USD-2 REGULUS II

4 AIR-BREATHING MISSILES

All of these missiles are really planes without pilots — fly without the extra weight, bulk, and appointments necessary for the frail human agent. Here are pilotless bombers — faster, less vulnerable, less visible to human and electronic eyes than their manned counterpart. Here, too, are the crewless craft which fly only to be shot down: the decoys and the flying targets. Here are fighter planes deadlier than ever with electronic pilots at the controls; and here are the surveillance drones, the spies in the skies over battlefields — reconnaissance robots to keep a sharp eye on hostile troop movements, troop concentrations and combat gear.

Rheem's AN/USD-2 combat surveillance drone shown at lower right above is the most advanced pilotless aircraft for gathering information on enemy battlefield areas available in the world today. It is a proved high performance aid for field commanders and a significant break-through in combat surveillance for the modern U. S. Army. High performance, utility and reliability have been packed into the smallest, simplest and most economical vehicle possible. Developed and manufactured by Rheem's Defense and Technical Products Division for the Signal Corps, the AN/USD-2 drone is mobility itself, even on the ground — four of them fit into a single standard Army truck and each drone can be launched from a small standard Army trailer (No airport is required). Rheem also provides important components of the drone's telemetering and ground support systems which can be easily moved in standard Army trailers.

At Rheem's Defense and Technical Products Division, advanced decoy penetration and surveillance drone systems are conceived, evaluated, designed and developed. Propulsion system analyses and explosive and ordnance development are other primary areas of endeavor. Complementing these activities, the division's Electronics Department provides components, instruments and systems for many of the nation's major ballistic missiles. The division also builds major components for missiles and aircraft.

For information on the capabilities of the Defense and Technical Products Division write for data file CA-100.

Rheem

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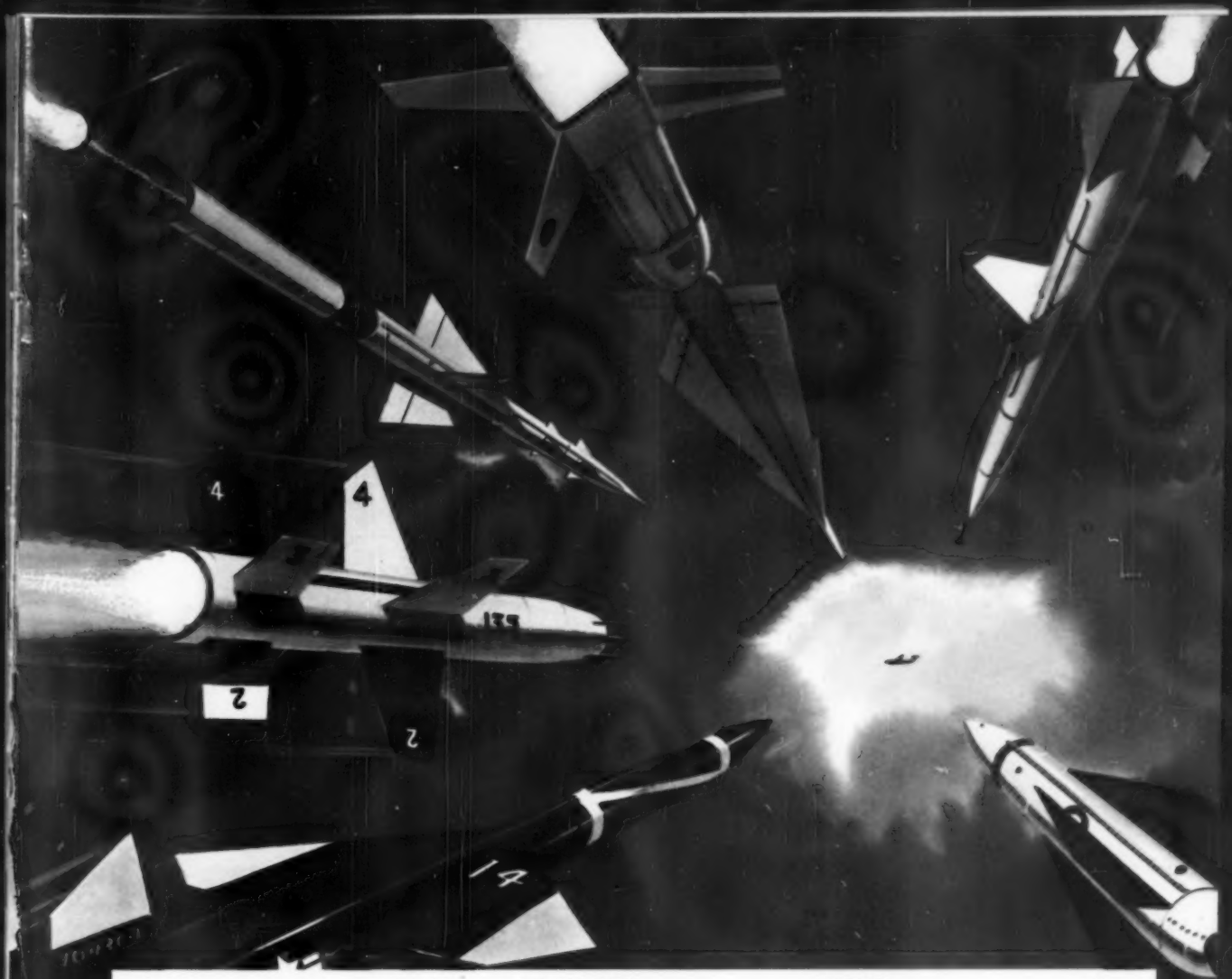
Engineers: Join Rheem in challenging technical work.



BOMARC TALOS NIKE AJAX NIKE HERCULES TERRIER HAWK

5 GROUND-TO-AIR-MISSILES

These are the anti-aircraft guns of the missile age. Poised at the gates of our cities, hidden in northern wastelands, or rising from shipboard mounts, hundreds of U.S. defense missiles are ready now to fling themselves at hostile H-bombers. They complement the deterrent power of the Strategic Air Command. In full production, these pilotless interceptors are more than a match for the swiftest manned jet or air-breathing missile known. The successors to the missiles featured above, the fantastic Anti-Missile Missiles, will be able to meet tomorrow's ballistic rockets on even terms.

Westinghouse technology is geared to the pressing problems of the space age — from missile guidance systems to materials for successful nose cone re-entry to a practical power plant for the moon. Vast resources of the corporation mean missile capability.

At the Westinghouse Advanced Systems Planning Group (WASP), scientists are determining long range military systems and space requirements — and planning weapon systems and programs capable of meeting these requirements.

The Westinghouse Astronautics Institute is exploring such areas as space stabilization, orbital injection, space guidance and satellite communications.

Westinghouse is spending $185 million for research and development in 1959. Current projects which will count heavily in missiles and spacecraft yet to come include: pulse doppler radar in three major areas of application . . . infra-red, including thermal imagery, ultrasensitive doped crystal detectors, and photo-electric magnetic detection.

Westinghouse is a pioneer in all phases of airborne, ground and ship-based electronics, electrical systems, propulsion, and underwater ordnance.

High standards of professional competence at Westinghouse assure military items of the highest quality and reliability, delivered on schedule.

Westinghouse DEFENSE PRODUCTS

AIR ARM DIVISION
AVIATION GAS TURBINE DIVISION
ELECTRONICS DIVISION
AIRCRAFT EQUIPMENT DEPARTMENT
ORDNANCE DEPARTMENT

YOU CAN BE SURE... IF IT'S Westinghouse

GENIE SPARROW III ZUNI SIDEWINDER FALCON

6 AIR-TO-AIR MISSILES

Armed with air-to-air missiles, and riding an airplane with the characteristics of a missile, today's fighter pilot is just a link in the control chain of a weapons system. He may never touch the controls from takeoff to landing — the hunt, the chase and the kill is done by the black boxes that come along for the ride. The fighter pilot of the missile age does not even have to aim his slim shafts of destruction. Most will seek out and hit a hostile plane or missile in spite of evasive maneuvers — and the nuclear-tipped variety will vaporize any aircraft within 1000 feet of their atomic fury.

High-performance missiles call for ultra-high-speed reflexes — and that's where rugged, compact *Torrington needle bearings* come into their own. Remarkably strong for their size and weight, Torrington bearings take the friction out of many types of missile equipment, such as control surface supports, actuators, ground and air launchers. *Mass-produced,* but engineered from the start to *missile precision standards,* with missile requirements in mind, Torrington bearings achieve highest capacities, utmost reliabilities from units as remarkable in their *economy* as for their technical perfection.

Current Torrington *research and development* programs promise to bring about needle-and-roller bearings for sustained operation beyond 1200°F. Bearings of this type would find their application on missile hot spots — such as rocket nozzles, combustion chambers, ramjets and afterburners. Designs already evolved from the Torrington test program are actually *ahead of most temperature requirements.* All the important data gathered in these advanced tests is available to designers. *Find out about Torrington bearings, their characteristics and applications at an early stage in your planning; call in your nearest Torrington representative, or write:* **The Torrington Company, Torrington, Conn. — and South Bend 21, Ind.**

TORRINGTON BEARINGS

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • BALL • NEEDLE ROLLERS • THRUST

Chamber Simulates Space Environment

By Michael Yaffee

Dayton, Ohio—Universal test chamber to simulate all environmental factors from 75,000 ft. out through interplanetary space is a new development goal of the Air Force.

Next October, Ohio State University is scheduled to complete a year-long study for Wright Air Development Center on planetary and interplanetary environments and methods of simulation. The report will present the latest facts and suppositions on environments —natural and induced—about what a vehicle would encounter in traveling through interplanetary space and in landing on other planets. It will detail methods of simulating these environments in a laboratory and then present plans for building such a facility, giving tentative layout, equipment required and probable costs.

Current Project

Current Ohio State project is actually a follow-on to a recently published Radio Corp. of America report for WADC on hyper-environments and methods of simulation which covered the same topics for the region from 75,000 ft. to 400 mi. Initiated just before the first satellite launching, the RCA study concerned itself primarily with the region in which future USAF weapon systems were expected to operate (AW Mar. 24, 1958, p. 73).

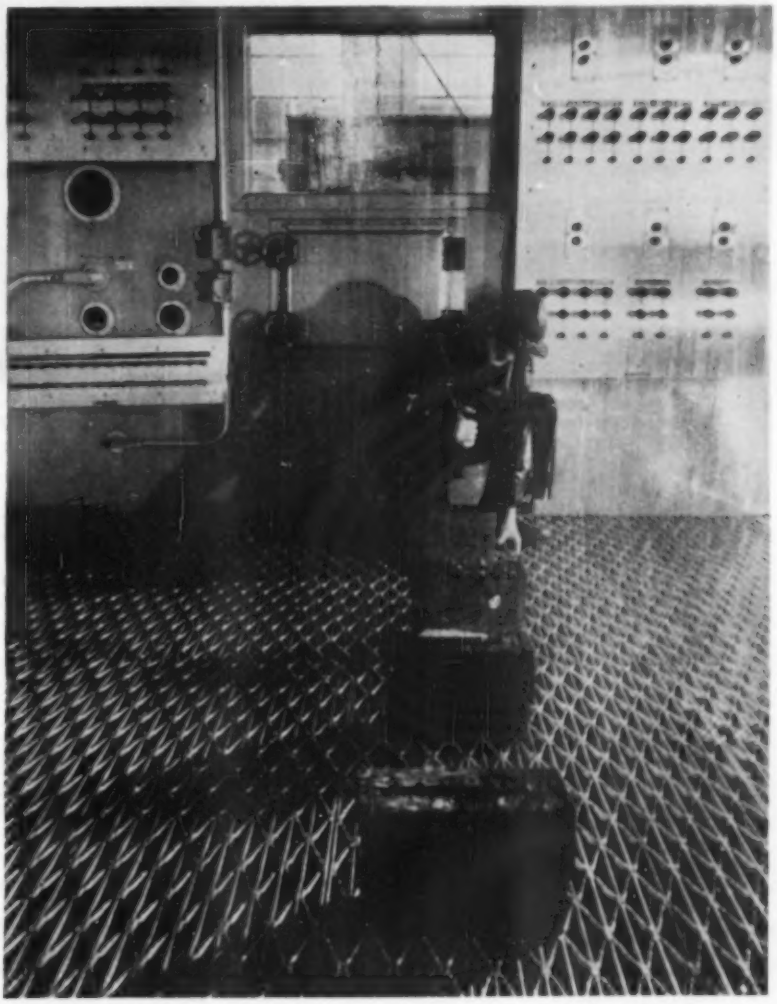
On the basis of these and some related studies, the Air Force is planning to ask Congress for money this year to get started on the universal simulator. The RCA report estimated the cost of the original Hyper Environmental Test Facility at $5,417,000 exclusive of engineering, land and utilities costs. Extension of the simulation range to interplanetary conditions is expected to push the price of the unit —now tentatively called Hyper Environmental Multiple Research Facility—to above $8 million. It will take about three years from the time work begins until the facility is operational.

Simulation Subject of Study

The problem of nuclear environment simulation, considered a major program in itself, was made the subject of a separate Air Force-sponsored study. This study, since completed, is serving as the basis for the Nuclear Engineering Test Facility which is now under construction at WADC. Scheduled to become operational in 1960, this facility will be a big unit that will be capable of simulating radiation, principally from reactors, at altitudes up to 200,000 ft. and possibly higher later. Simulation of the high intensity radiation belt above the earth, which was unexpectedly turned up by the Explorer III satellite, will also be assigned to the facility since it bears some relation to reactor radiation. Wright Air Development Center is also carrying out a number of studies, some in WADC to find out what combinations of environments can be simulated most effectively, which ones are no longer important, and of the new simulation programs proposed, which might better be assigned to existing facilities.

No Air Force study is expected to serve as an actual blueprint for the final facility. Principal purpose is to provide Wright Air Development Center with a basis on which to request bids from potential contractors, who themselves may suggest more effective or less costly approaches.

Ideally, WADC scientists would like to have a simulation unit in which they could place a complete Atlas intercontinental ballistic missile or space



RAIN and sunshine chamber at Frankford Arsenal will simulate rainfall of 0.5-in. to 24-in. an hour and natural sunlight as well as tropical and desert air conditions. Demineralized water, which is continuously filtered to remove contaminants, is recirculated through chambers. Windows are equipped with windshield wipers.

Checking Regulus I surface-to-surface missile prior to launching from experimental cart. For the use of Ni-Cr-Mo steel castings in the launching cart, Chance Vought was judged a National Award Winner in the Third Product Development Contest conducted by the Steel Founders' Society of America.

How castings of 4330 nickel-alloyed steel help boost a missile up, push assembly cost down

20-Ni-Cr-Mo steel castings replace 73 detail parts, eliminate 300 hardware items in new launching cart

Regulus I, made by Chance Vought, is normally boosted skyward from a rail launcher. The Navy, however, wanted a more economical launching technique that would utilize a carrier's powerful catapults . . . that would also simplify handling of the missile aboard ship.

The answer was the expendable catapult cart you see above.

The carts, also made by Chance Vought, are assembled with 20 cast 4330 steel cluster joints welded to tubing of the same material. These castings replaced 73 detail parts required in the plate-type fittings of the experimental units used to prove the idea. They also eliminated 300 hardware items, such as nuts and bolts. Assembly is easier, and far more economical.

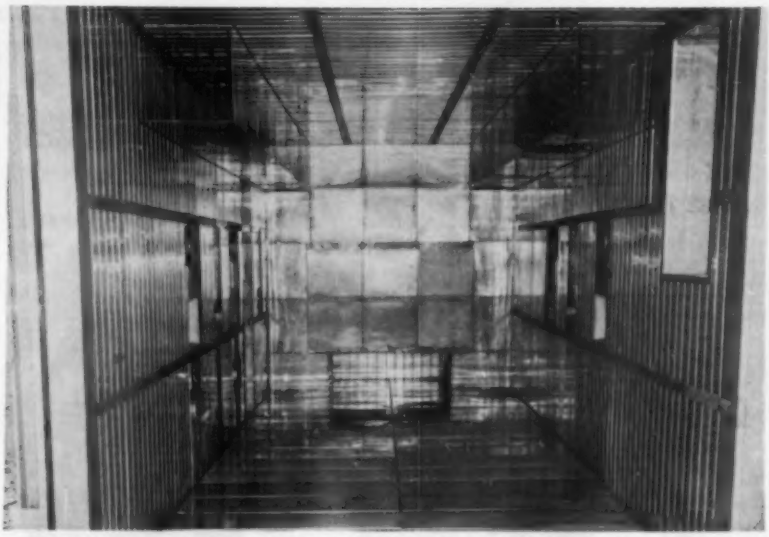
Why Ni-Cr-Mo steel for the castings? The 4330 composition of 1.8% Ni .65% Cr. .25% Mo heat treated to 125,000 and 150,000 psi gives these castings the combination of high strength and great toughness needed to stand up to the tremendous shock of take off.

What about your product? Can it use the economy, high strength, and shock resistance offered by Ni-Cr-Mo steel castings? You can get complete information by writing:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

INCO NICKEL

NICKEL MAKES ALLOYS PERFORM BETTER LONGER



ENVIRONMENTAL test chamber, built by Tenney Engineering for McDonnell Aircraft, will simulate temperatures from —100F to 1,200F, altitudes to 150,000 ft. and ram airflows up to 100 lb./min. at 75,000 ft. Walls are 2-ft. thick steel sandwiches with 1 ft. of foamed glass insulation in between. To get uniform circulation, air is blown through two upper ducts and returns through lower duct on opposite wall. Chamber cost $500,000.

vehicle, put a punched card in a computer and have the chamber exactly reproduce the entire environmental pattern the vehicle would encounter if it were actually to fly the programed course.

However, says one Wright Air Development Center scientist, the proposed Hyper Environmental Multiple Research Facility together with existing simulation equipment and the radiation unit under construction would give the Air Force everything it actually needs for this work.

As now planned, the facility would be located at Wright Air Development Center close by existing simulation units and would be used by the Air Force for its own experimental work. Among other things, it would be used to develop test chambers and means of simulation to prove that certain environments can be adequately simulated before any actual specifications are written.

Industry's Facilities

Industry, it is hoped, will have its own facilities, perhaps on a cooperative basis. Because aviation companies are interested primarily in simulation and not in the same kind of experimental work that the Air Force is required to carry out, a WADC scientist points out, they could get by nicely with a unit comparable to the original Hyper Environmental Test Facility outlined in the recent RCA report and costing considerably less than the proposed WADC unit. Either facility, of course, would be a big advancement over current simulation methods and equipment.

At present, Air Force items are subjected to simulated environments as described in specification MIL-E-5272. Included here are such environments as shock, vibration, explosion, temperature, humidity and fungus.

But these environments, states the RCA report, are actually only valid for testing equipment to be used in present-day aircraft.

Future Weapon Systems

Future USAF weapon systems will be operating in different environments—natural and induced—from those normally encountered today. These will be the so-called hyper environments which will be found at altitudes above 75,000 ft. and below 400 mi.

For purposes of their study, RCA's R. A. Di Taranto and J. J. Lamb selected the hyper environments having the most deleterious effects on flight vehicles of the future as those being the most important to reproduce in an environmental test chamber; proposed methods of simulating these environments; listed equipment required, suggested size and layout of the individual units; and gave estimated costs.

In most cases, of course, those vehicles that will operate at altitudes above 75,000 ft. will also have to pass through the various environments from sea level to 75,000 ft., many of which will not be able to be simulated in a hyper environmental test facility.

Those environments that will have to be simulated separately, according to

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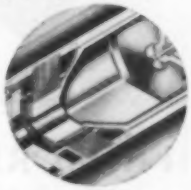

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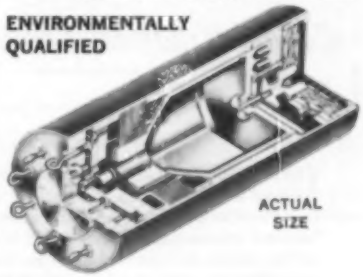

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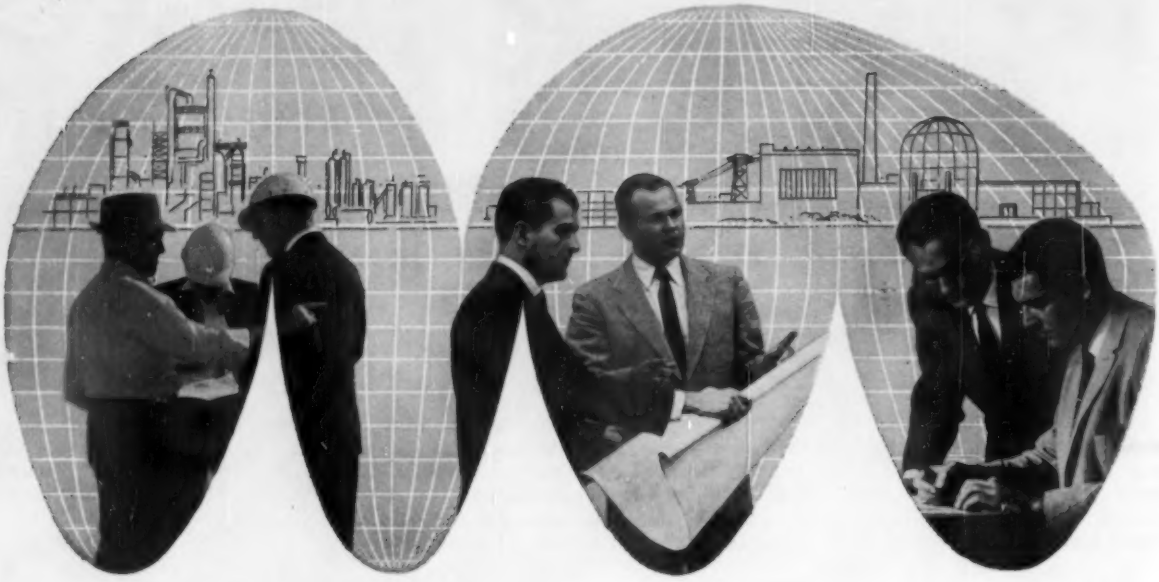

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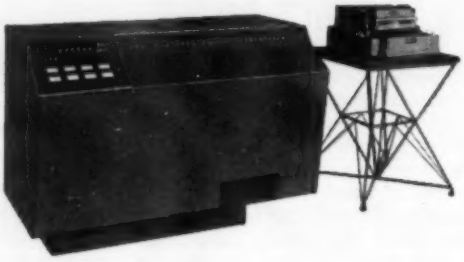

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Hyper Environmental Simulation Facility

Condition	Test Unit	Area Required	Cost (est.)	Capability	Remarks
High vacuum	Cylinder, 9 ft. (diam.) x 15 ft., with pumps	1,200 sq. ft.	$200,000	6 x 10^{-9}mm Hg. (150-mi. altitude)	Ultimate goal is to approach perfect vacuum of space
High temperature	3 ft. x 3 ft. x 6 ft. sheet metal enclosure heated by infrared lamps	900 sq. ft.	$115,000	1,000F (can be increased if needed)	To be used for temperature-shock and steady-state high temperature testing.
Air cooling	High altitude chamber through which conditioned air is blown	5,100 sq. ft.	$200,000	Air flow from 6 to 100 lb./min., from −40 to 250F	To simulate air cooling of equipment from sea level to 100,000 ft.; future goal is increased flow at higher altitude.
Solar radiation, ozone and ionization	Vacuum chamber, 9 ft. x 15 ft., with carbon arc lamps, ozonator and electric field equipment	1,800 sq. ft.	$475,000	Entire solar spectrum at 100,000 ft., 300,000 ft. and 600,000; entire range of ozone concentration up to 11 ppm at 100,000 ft.; ion densities at 300,000 ft. and 600,000 ft.	Ultimate goals to simulate unabsorbed solar spectrum at 1,500,000 ft., to attain maximum ionization at 1,000,000 ft. to simulate other planetary atmospheres when they become known.
Vibration	Three shaker tables in hemispherical chambers	1,670 sq. ft.	$370,000	12,500 lb. force to 2,000 cps. at 1,000F or to 100,000 ft.	Will modify vector forces and frequencies as future measurements indicate.
Acoustic excitation	Underground noise chamber with sirens, amplifiers and heat source	1,068 sq. ft.	$600,000	Up to 174 db. over 30 to 10,000 cps. with heat to 1,000F	Goal is to develop a high intensity wide-band acoustic noise source.
Shock	Two hydraulic generator shock machines in heating chambers	1,670 sq. ft.	$42,000	Can shock in three mutually perpindicular planes at temperatures to 500F and altitudes to 100,000 ft.	Will modify shock pulses as measurement indicates.
Acceleration	35 ft. radius centrifuge in test chamber with heat source	5,830 sq. ft.	$1,550,000	300 gs with 1,000-lb. load at temperatures to 1,000F	Plan to include vibration in this facility.
High-speed particles	Shaped-charge apparatus and projectile tube.	3,150 sq. ft.	$55,000	1-gram particles to 15,000 fps.; sputtering by air molecules to 25,000 fps.	Ultimate goal is to attain particle speeds from 35,000 to 240,000 fps. and continuous source of high speed particles.
Explosive decompression	Shock tube, 9 ft. (diam.) x 50 ft., with vacuum pumps	920 sq. ft.	$63,000	Hypersonic shock wave	Membrane separates pressurized (20.5 psia.) equipment section from evacuated (0.5 psia.) section.

the RCA report, are: humidity, salt spray, fungus, sand and dust, explosive atmosphere, rain, and blowing snow. Except for the last, however, all these conditions can already be simulated in existing facilities at WADC.

Combined Environmental Testing

Another WADC report, "Feasibility of Combined Environmental Testing" by W. J. Carey and G. Kollin, goes into detail on the important problem of combined environmental testing. Engineers have found that materials, structures and equipment that can withstand specified levels of temperature, vibration, altitude, etc., in individual tests often fail in actual flight where these conditions are combined.

In their report, Carey and Kollin list the following combinations of environments as the principal ones required:

- **Vibration,** shock, blowing snow and low temperature.
- **Vibration** with rain, sand and dust, sunshine, or salt spray.
- **Any or all** combinations of high or low temperature, altitude, temperature-condensation, temperature-shock, ozone, acceleration, shock, and explosive atmosphere.

The RCA report does not consider the matter of adding these combined environments other than to point out that layout of the proposed hyper environmental facility allows for additional building area.

As far as the environmental equipment manufacturers themselves are concerned, however, the simultaneous simulation of different environment is regarded as one of the most significant and most active developments in this field at present. New combination testing facilities, according to environmental engineer Frank Gardner of Tenney Engineering, Inc., will eventually be able to eliminate 50% of recurring missile test failures and are definitely the trend today.

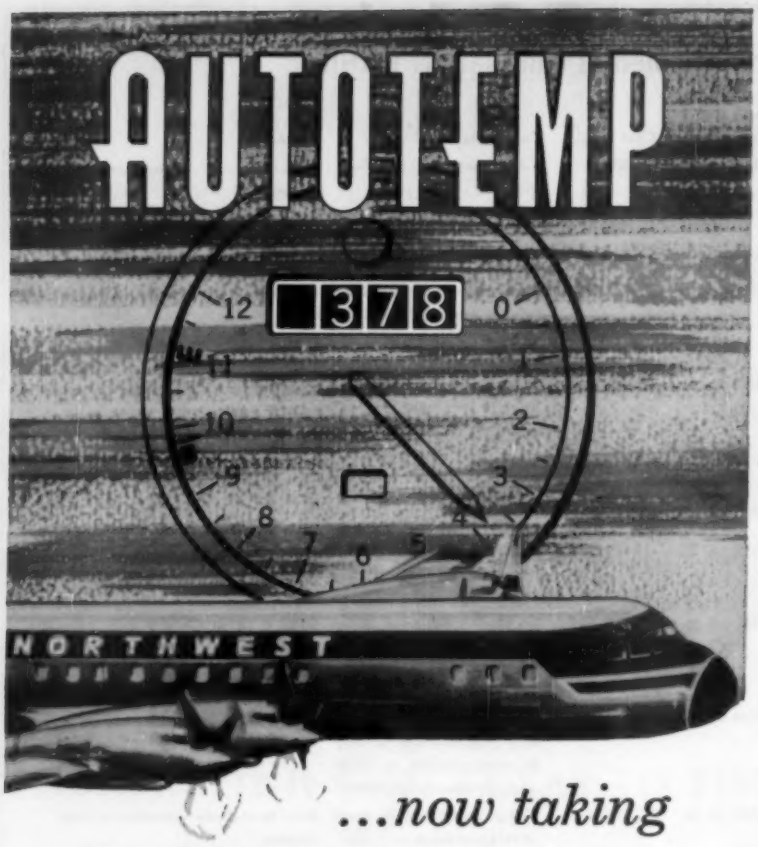
Already a comparatively common unit in the aviation industry now is the combination altitude-temperature-vibration chamber. One of the largest is the 12 ft. x 14 ft. x 18 ft. chamber Tenney has made for Sperry Gyroscope Co.

Temperature Range

The facility will have a temperature range of −100F to 450F, an altitude capability of 120,000 ft., and ram air simulation. The vibration machine will generate 21,500 lb. of force at 2,000 cycles per second.

Exclusive of the vibrating unit, which Tenney doesn't make, the chamber cost $350,000.

The next step beyond the Sperry facility, says Tenney, will be the same combination of environments but with much higher altitude capability. Then will come the addition of a radiation



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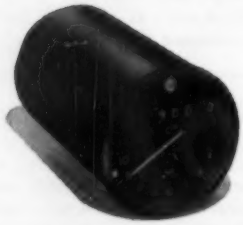

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source, possibly in combination with ozone and ionization uits.

Another advanced association will be acoustic excitation, shock and acceleration, which may be combined with temperature but none of the others in the first group. High speed particles and explosive decompression will remain strictly individual tests.

Price Rise

With each combination of simulated conditions, of course, the price goes up. Tenney, for example, is now drawing up plans for a 10 ft. x 10 ft. x 20 ft. facility which can be used for both personnel and equipment testing. It will be able to simulate altitudes from sea level to 500,000 ft., making the transition from one to the other in 20 min. Temperatures inside the chamber will go from ambient to 1,200F in 45 min., and from ambient to −100F in the same amount of time.

In addition, the chamber will have a unit for simulating all radiation below ultraviolet.

Estimated cost is about $600,000 just for the chamber. Adding water, power, 853 and installation costs could raise the final price to $3 million. Yet, this is still only slightly more than half the estimated cost of the hyper environmental chamber already needed by aircraft and missile manufacturers and only about one-third the price of the unit desired by WADC.

The rapidly increasing speed and altitude capabilities of modern aircraft and missiles have not only boosted the cost of the individual chambers required to simulate their new environments but have also created a small boom in the whole environmental equipment industry. Sales last year ran to more than $8 million and are expected to reach $9 million this year—almost double the 1952 figure. The aviation and allied industries such as avionics, it is estimated, account for approximately 75% of the total.

Sharing the Boom

Sharing the boom with Tenney Engineering, which is considered the largest in this field, are roughly 50 other producers and assemblers. Among the more important companies on a sales basis are Murphy & Miller, Inc.; Conrad, Inc.; and Guardite Co., division of American-Marietta. Most of these companies consider the business custom work and don't see the day when it will be anything else. Seldom, if ever, have two test chambers been ordered that were exactly alike. But aware of the possibility that one order for a hyper environmental facility could double the industry's total annual sales, they consider the growth prospects better than ever.

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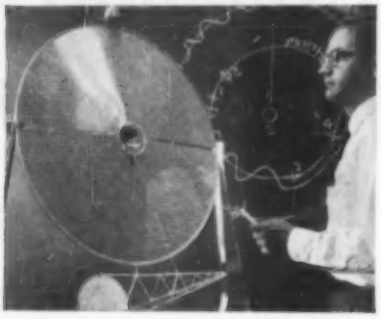

1/20th scale model of unmanned Martian reconnaissance vehicle, a Boeing study project.

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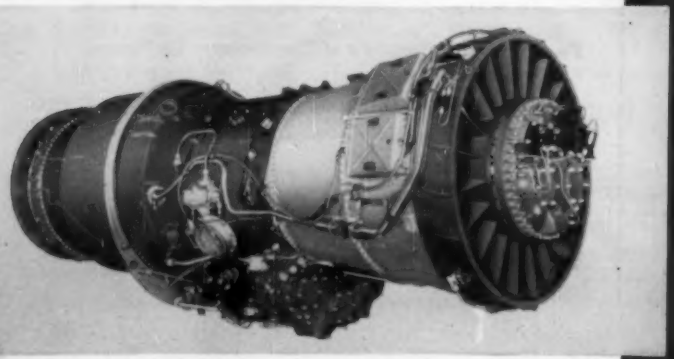

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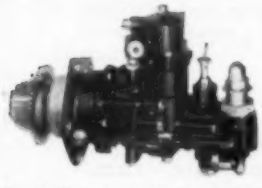
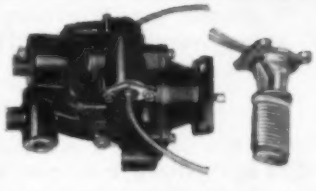
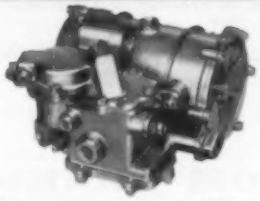
A few of Holley's Engine Accessories for Jet Aircraft



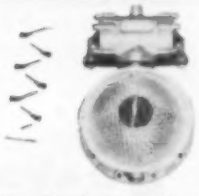
The Holley designed R-92 Compressor Bleed Governor for the Pratt & Whitney Aircraft JT-3 and J-57 Jet Engines.



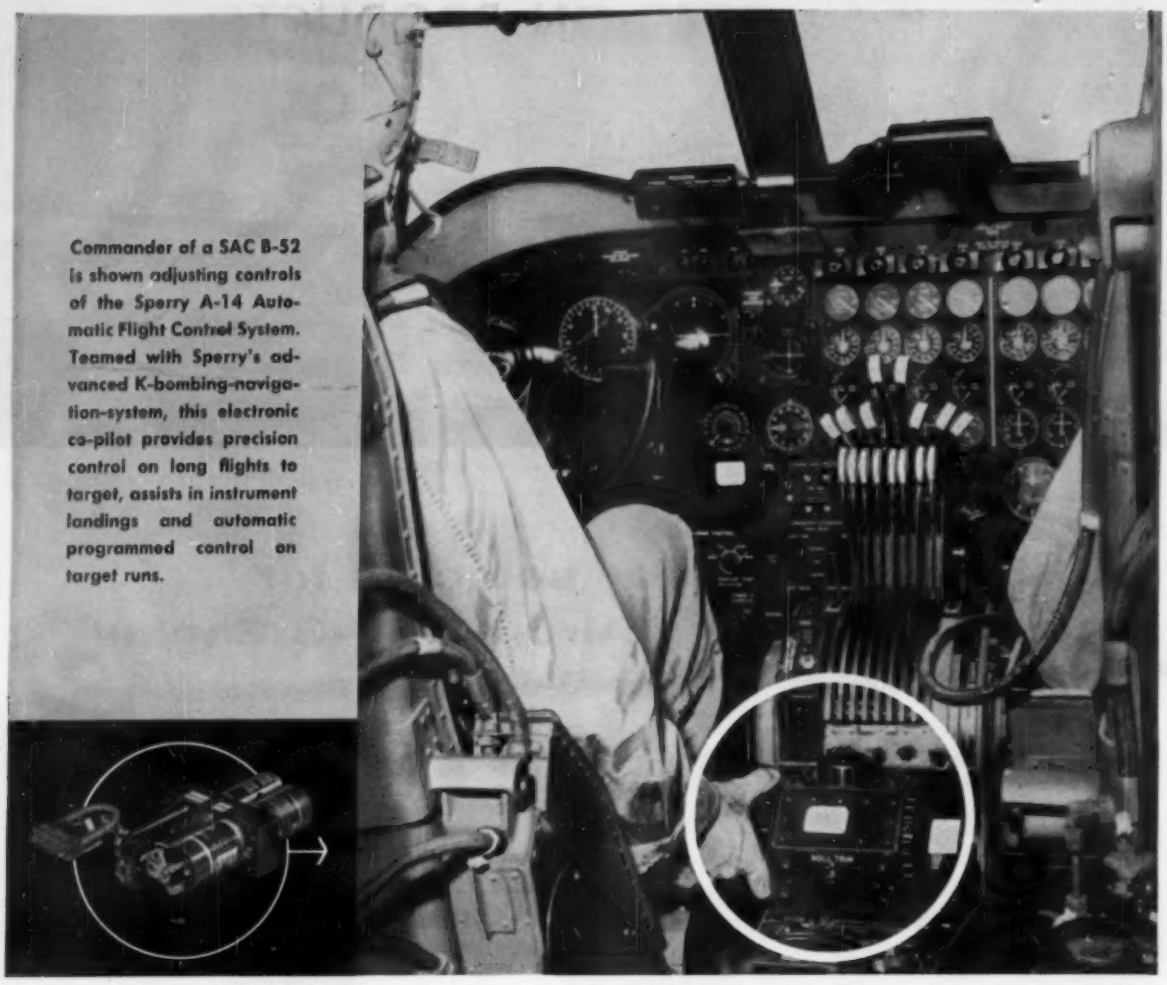
A companion to the actuator is the R-98 Compressor Bleed Governor for the JT-4 Jet Engine.



Designed for Pratt & Whitney Aircraft JT-4 Jet Engine, the R-98 Bleed Piston Actuator is Holley designed and manufactured.



This bleed valve and actuator for the JT-3 Jet Engine is manufactured to Pratt & Whitney Aircraft design by Holley.



Commander of a SAC B-52 is shown adjusting controls of the Sperry A-14 Automatic Flight Control System. Teamed with Sperry's advanced K-bombing-navigation-system, this electronic co-pilot provides precision control on long flights to target, assists in instrument landings and automatic programmed control on target runs.

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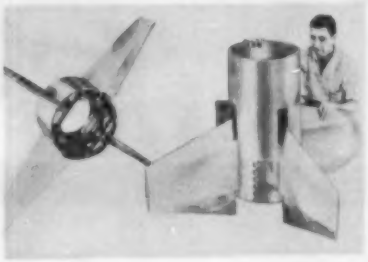
Missile Tail Fins

Cruciform tail fins of several sizes to conform to varying test loads are available for Nike, Honest John, Lance, Sergeant and other missiles.

Fins, composed of two castings and



two side plates, are welded to a barrel that fits the missile motor. Barrel is made of 16 castings, four to a quadrant, which are welded to the root of the fins and fastened by means of pin. This permits variations in individual fin areas. Fins are static load tested in both lift and drag directions.

Aerolab Development Co., 330 West Holly St., Pasadena, Calif.

Cabin Air Control

Cabin air temperature control assembly is designed to regulate passenger cabin air on the Boeing 707.

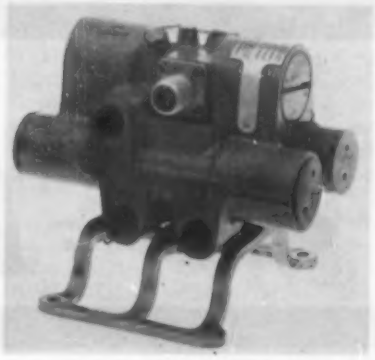
Assembly consists of three six-inch valves, two cold air and one hot air, and an electric actuator. The butterfly type valve move through 90 deg. and operate in temperatures from −65 to +165F. Total weight of assembly is 13.4 lb.

Chandler-Evans Corp., West Hartford 1, Conn.

Solenoid Selector Valve

Six-way, four-position solenoid operated selector valve controls the landing gear and landing gear doors in a 3,000 psi. aircraft hydraulic system.

HP466100 valve is ported to com-



bine two valves into one package, eliminating two solenoids and two hydraulic line connections.

Hydra-Power Corp., Pine Court, New Rochelle, N. Y.

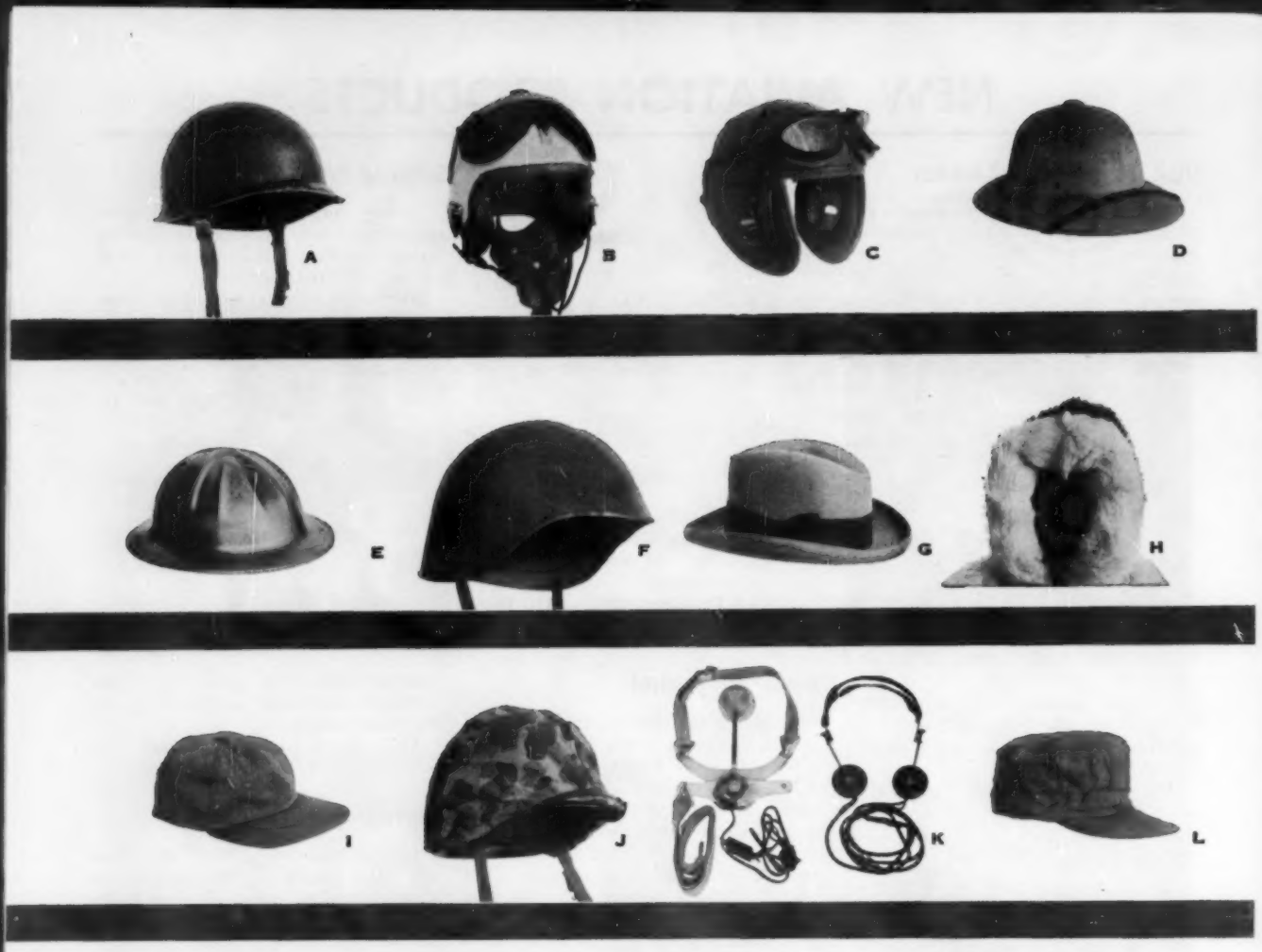
Turboprop Engine Mount

Rubber-insulated, forged aluminum and steel engine mount is used to mount he Lycoming T53-L-3 turboprop engines on the Grumman YAO-1 observation aircraft.

Three MB 6000 vibration-dampen-

Helicopter Rescue Hoist

Rescue hoist developed for the prototype Kaman HU2K-1 Navy utility helicopter weighs 29½ lb. Hoist, utilizing a five-layer cable wrap to reduce spool size, will lift a 600 lb. load at 100 fpm. on a 100 ft. cable. Hydraulic motor above provides lightest weight configuration, but an electric motor may be fitted. Manufacturer is Haydu Electronics Products, Plainfield, N. J.



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And as for the many hats, those shown above have been worn on these representative programs: **A** *Integrated Battlefield Communication* **B** *Supersonic Rendezvous and Station Keeping* **C** *High-speed Tank Range Finder* **D** *Test Range Microwave Relay System* **E** *Ballistic Missile Radio Inertial Guidance System* **F** *Shipboard Surface-to-air Missile Guidance* **G** *Member, Army Scientific Advisory Panel* **H** *DEW Line Air Defense Radar* **I** *Strategic Bombing Radars* **J** *Amphibious Landing System* **K** *Shipboard Air Defense Data System* **L** *Tactical Drone Guidance.* For data on how Motorola's military experience can be applied to your problem... or for detailed information on engineering career opportunities... write to: Motorola, Inc., Military Electronics Division, Dept. A, 8201 East McDowell Road, Phoenix, Arizona.

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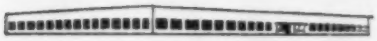
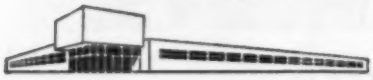
CHICAGO



PHOENIX

RIVERSIDE



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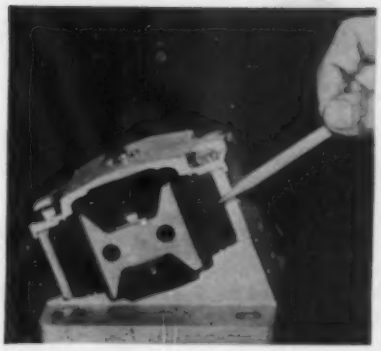
MOTOROLA

Military Electronics Division



ing units are used to mount the engine.

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WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Polymers Derived From Dihydroperfluorobutyl Acrylate—by F. W. Knobloch and H. C. Hamlin, Wright Air Development Center, U. S. Air Force, September, 1955. $1.00; 35 pages. (PB 131998)

Reference Index of the Current Protective Coatings Specifications—Ordnance Tank-Automotive Command, Detroit Arsenal, U. S. Army (No Date.) $3.00; 159 pages. (PB 151166)

Methods of Determining Surface Roughness—by M. K. Testerman, University of Arkansas for Wright Air Development Center, U. S. Air Force, June, 1958. $1.25; 48 pages. (PB 151268)

Investigation of Printed Circuit Methods for Relay Applications—by H. R. Reeve and R. L. Traas, P. R. Mallory & Co. for Wright Air Development Center, U. S. Air Force, August, 1958. $3.50; 233 pages. (PB 151259)

A High-Speed Electronic Printer for Digital Computer Output—by W. Scott Grant, Radiation, Inc., for Wright Air Development Center, U. S. Air Force, November, 1957. $2.50; 111 pages. (PB 151331)

Technology of Molybdenum and Its Alloys—A symposium sponsored by the Office of Naval Research, September, 1956. $.75; 16 pages. (PB 131793)

Selected Bibliography on Precision Instrument and Fluid Bearings With Annotations—by J. G. Weir, U. S. Naval Avionics Facility, March, 1957. $2.50; 103 pages. (PB 131791)

Stabilization of Computer Circuits—by E. Hochfeld, University of Chicago for Wright Air Development Center, U. S. Air Force, November, 1957. $1.00; 39 pages. (PB 151255)

Structural Evaluation of Beryllium Produced by Several Processes—B. B. Muvdi, The Martin Co., for Wright Air Development Center, U. S. Air Force, June, 1958. $2.00; 66 pages. (PB 151263)

Research on Electro-Optical and Magnetic Core Logic—by T. C. Marshall,

P6M Part Milled on Numerically-Controlled Unit

Fitting for the mine door of the Martin P6M Seamaster was machined from aluminum alloy on a numerically-controlled milling machine in about one-third the time required for conventional milling. Operation is an example of application of the APT system of automatically programing machine tools (AW Mar. 30, p. 95). APT (automatically programed tools) system was developed at the Servomechanisms Laboratory of M.I.T.

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Jr. and L. J. Andrews, National Cash Register Co. for Wright Air Development Center, U. S. Air Force, September, 1957. $1.50; 51 pp. (PB 151257)

Publications Received:

Dictionary of Astronomy and Astronautics—by Armand Spitz, coordinator of Visual Satellite Observations for the Smithsonian Astrophysical Observatory, Cambridge, Mass.; and Frank Gaynor, contributing editor, Encyclopedia Britannica. Pub. Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. $6.00; 439 pp.

Definitions of over 2,200 terms and concepts related to astronomy and astronautics.

Semiconductors—Edited by N. B. Hannay, Bell Telephone Laboratories, Murray Hills, N. J.—Pub. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. $15.00; 767 pp.

A reference on the physical chemistry and fundamental physics of semiconductors, with analyses of semiconducting materials.

Satellite Beacon

Miniature low-power transistorized subcarrier oscillator transmitter, originally built to broadcast tracking signal and temperature data from the Project Score "talking satellite," now is available in production quantities from Applied Science Corp. of Princeton (ASCOP). Transmitter, which has output power of 30 to 100 milliwatts, can be operated at any crystal-controlled frequency between 100 and 150 mc. The device is designed to be amplitude modulated, but phase modulation at subcarrier frequencies up to 22 kc. can be employed. Transmitter measures only 3¼ in. dia. x 1¾ in. long, weighs 12 oz. Total power consumption is 250 mw.

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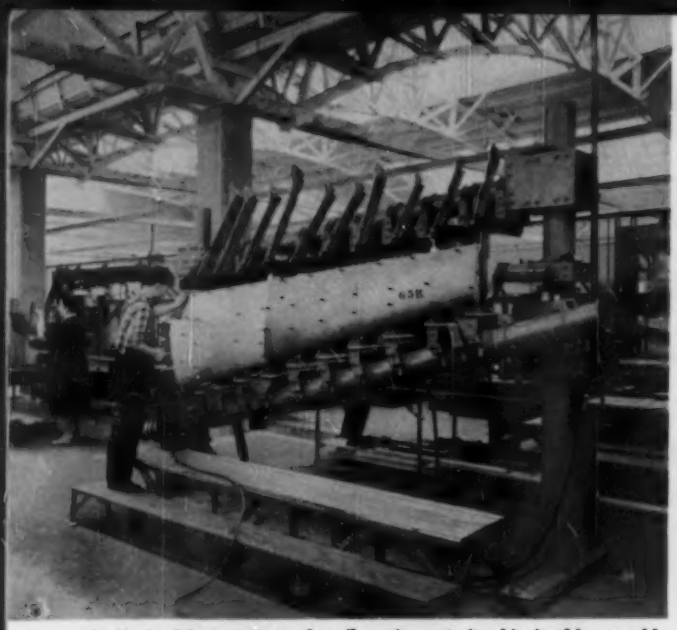
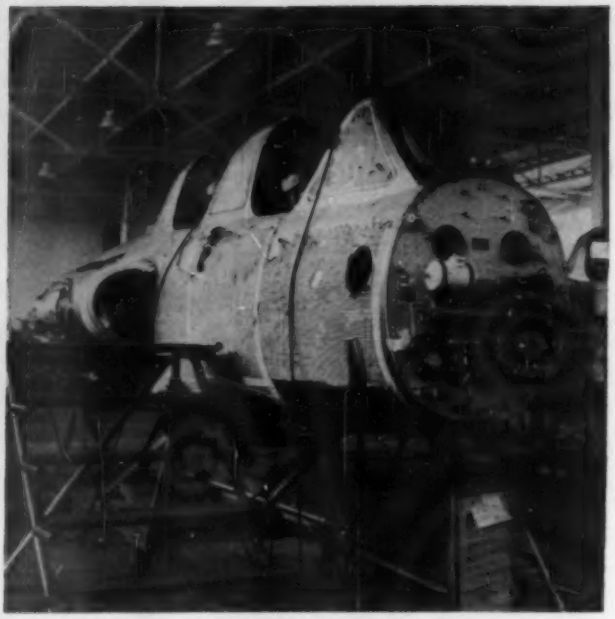


Half of a Magister butterfly tail section gets its skin in this assembly jig at Heinkel's Speyer plant.

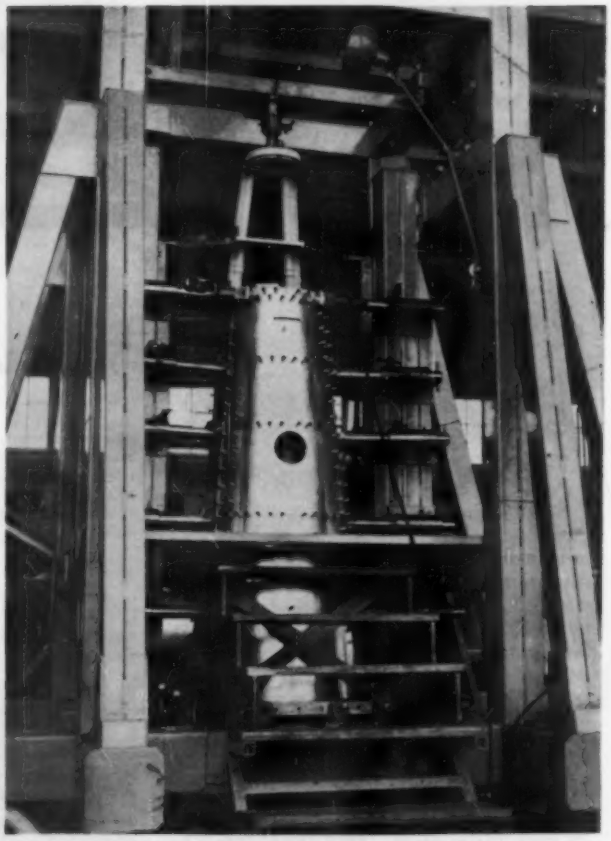


Controls, hydraulic and electrical lines and other accessories are installed in completed fuselage section.

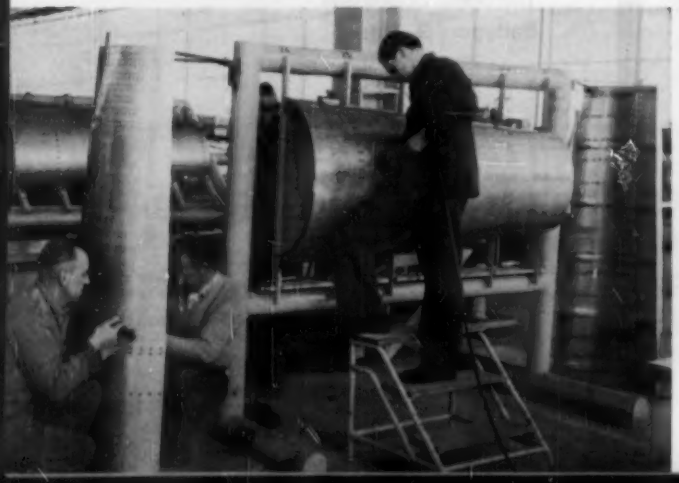
Germans Produce Fouga

Wing D-spar section is fabricated in separate jig; tolerances are very close. Over-all wing twist is 50 min. of arc.

Fuselage panel sections are unsophisticated. Shell components here are almost pure monocoque structure.



Rear section is skinned before final riveting in this jig at Messerschmitt's Augsberg plant.



Completed Fouga Magister fuselages receive final cleanup and inspection on these wheeled fixtures in one of the Messerschmitt assembly areas at Augsberg. From here, fuselages are trucked to Munchen-Riem for final assembly and flight tests.

Magister Trainers

German-built Air Fouga Magister CM-170R two-seat jet trainers, now in service with the Luftwaffe, are being produced at the rate of about 60 airplanes per month. First deliveries were made from a batch purchased outright from the French developers. Subsequent aircraft are being produced by the Flugzeug Union Sud of Munich, a joint company formed by Ernst Heinkel Fahrzeugbau GmbH. and Messerschmitt A.G. Heinkel is responsible for production of wings, empennage and fuselage forward nose section which contains nose wheel and guns. These components are made at the main Heinkel assembly plant at Speyer am Rhein. Messerschmitt turns out the complete fuselage at its plant at Augsberg and handles final assembly and flight tests.

Luftwaffe students pilot three Fouga Magisters on a formation training flight over Germany. The aircraft has been standardized as primary trainer in all-jet curriculum.

Leaving final assembly line, Fouga Magister gets final inspection before taking off on its initial test flight.

SMALL APPETITE NOISE SOURCES

service-proved and available now

Until recently signal simulators for monitoring radar receivers or microwave relays were of two types. One was a big and heavy ampere eater with cumbersome auxiliary equipment; and the other was a sensitive though delicate instrument suitable only for the laboratory.

We call your attention now to the Litton 2000 series of miniature gas noise sources. The Litton 2000 for waveguide use is pictured above. It has a first cousin, the Litton 2007 designed for coaxial cable use. We call your attention because most tubes in this series are now in production and we suspect there are frustrated design engineers who will receive this announcement with keen interest.

Our gas noise sources may properly be called miniature. They require only inches of space, smaller, lighter auxiliary equipment, and small voltages and currents. Around 500 volts fires them; 100 milliamperes maintains them. These characteristics, plus others, have caused them to find numerous applications: for in-flight calibration and test of aircraft microwave receivers; as *automatic* watchdogs on airborne radar systems; and in other systems which require various immunities to vibration, shock, humidity, and temperature cycling.

The Litton family of miniature gas noise sources, like all Electron Tube Division products, was designed to solve specific end item functions. We have found that this philosophy contributes to consistent reliability: tubes do their jobs more efficiently, for longer periods of time, and at lower overall cost to the buyer. Other advantages also result. For example, these noise sources require *no* ageing-in and the L-2000 is replaceable in the field without changing the mount.

Specific frequency ranges in L, S, C, X and K bands are covered. If you are concerned with radar transmission, or with microwave data links of any kind, we'll gladly send you more information. Write to Litton Industries Electron Tube Division, Office A5, 960 Industrial Road, San Carlos, Calif.

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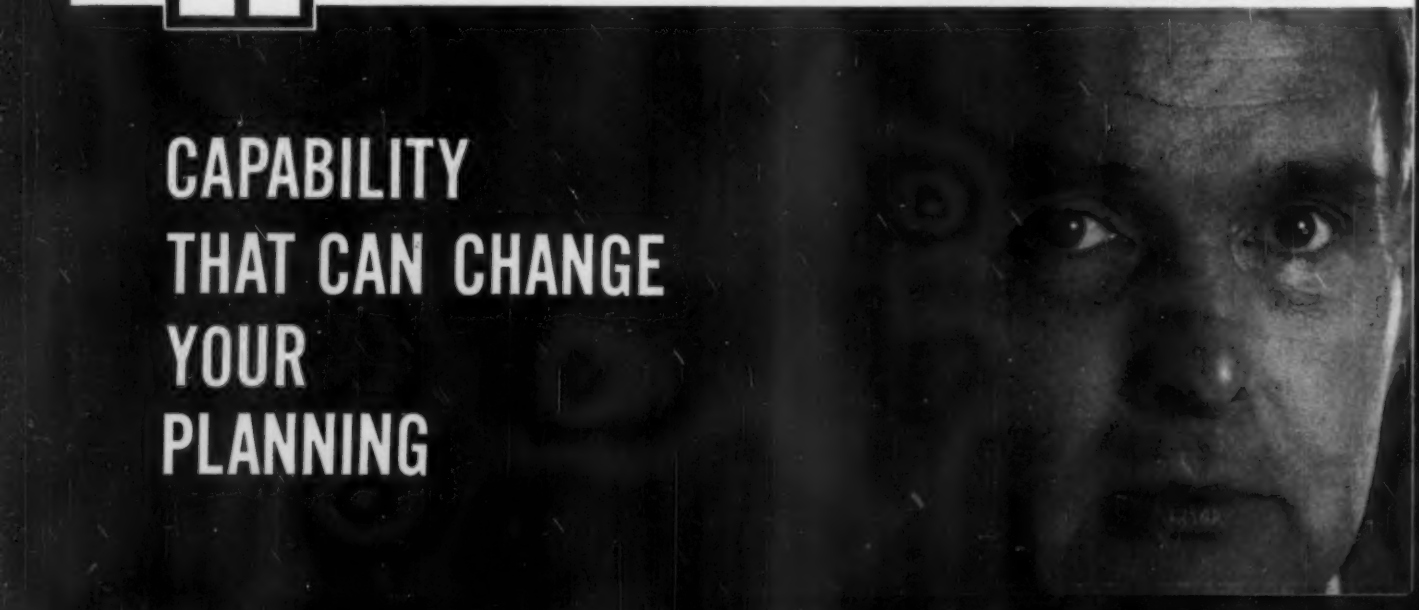
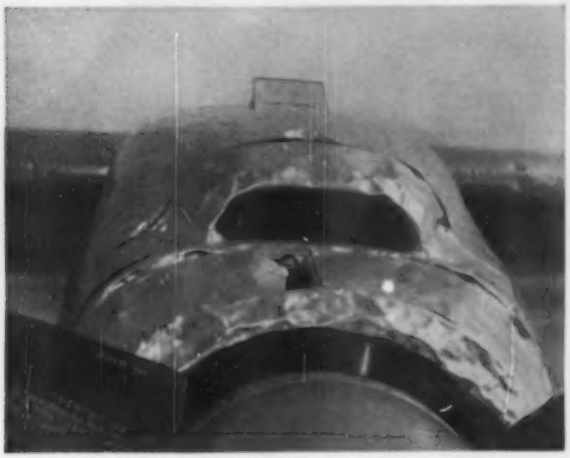
CAPABILITY THAT CAN CHANGE YOUR PLANNING



Hail tore C-133's radome cover, smashed windshield panel.

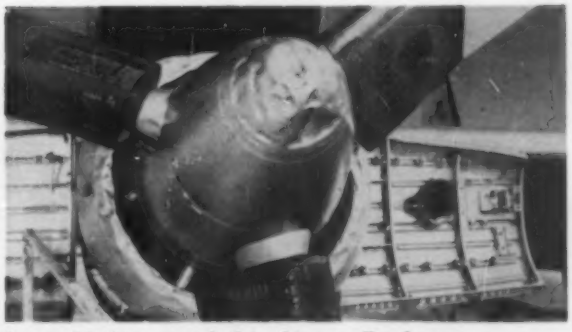
Glass shards from windshield narrowly missed pilots.



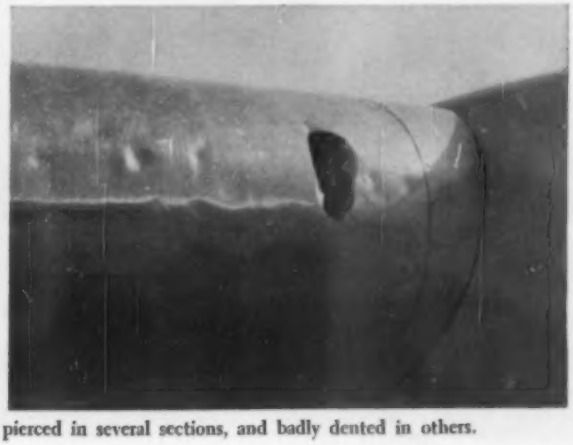
Nacelle leading edge and intakes were dented by hailstones.

Hailstones Severely Damage C-133 Transport; Crew Unhurt

Short barrage of hailstones, estimated at only 30 sec., severely damaged a Douglas C-133 turboprop transport but the aircraft continued for another 200 mi. before landing safely. All four Pratt & Whitney T34 engines functioned normally although oil coolers were heavily damaged. Crew said the hail storm never appeared on the APN-59 radar. Most serious immediate danger came from flying glass; leading edges of wing also were damaged, necessitating a landing made at a speed slightly higher than normal. The C-133 was heavily loaded at the time. Repairs will require about 14,000 man hours. There were no injuries.



Force of hailstones resulted in this propeller damage.



Hailstones hit the C-133 with such force that wing leading edge was pierced in several sections, and badly dented in others.

...NEWS IS HAPPENING AT NORTHROP

RADIOPLANE PRODUCES FIRST COMBAT-READY SURVEILLANCE DRONES

NEW SD-1 PROVIDES AN EYE IN THE SKY FOR ON-THE-SPOT BATTLEFIELD SURVEILLANCE

RADIOPLANE

In production and being delivered to the Army Signal Corps in operational quantities, the SD-1 is proved and ready to fly unmanned photo reconnaissance missions for tactical troops. Meeting tough Signal Corps standards, this Radioplane drone exemplifies Northrop Corporation's close cooperation with the U.S. Armed Services. Northrop-Armed Service teamwork provides an early awareness of future defense needs—enables a years-ahead start on vital research and development. Northrop management contributes cost-minded creativity, producing earlier effective answers to international defense problems – delivered at minimum cost.

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USAF's soon-to-fly T-38 Talon delivers combat-calibre performance at minimum cost; will train America's new generation of supersonic pilots and spacemen.

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Johns-Manville announces new MIN-KLAD Insulation!
This one new product answers 4 basic thermal and mechanical requirements
low conductivity
high heat capacity plus erosion resistance
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Asbestos-reinforced plastic
Min-K insulation

New Min-Klad insulation is engineered and molded to your design requirements.

Combines the capabilities of asbestos-reinforced plastic with the dramatically low conductivity of MIN-K insulation!

New Min-Klad insulation may well be the most significant advance ever made in missile and rocket insulation.

Developed by Johns-Manville research scientists, Min-Klad is the only product of its kind, a permanent lamination of the missile industry's two most effective high-temperature materials: 1) reinforced plastic and 2) J-M's recently developed Min-K insulation.

Does more than plastic alone

Min-Klad gives the missile designer all the advantages of high-temperature plastic: Strength, toughness, rigidity! Erosion resistance! High heat capacity! Yet Min-Klad does more.

It also insulates . . . and with dramatic effectiveness! Its insulating element is J-M's Min-K, an insulation with thermal conductivity that is lower than any other known insulation. Actually lower than the molecular conductivity of still air. And this conductivity (already less than half that of the best fibrous insulations) drops still further with altitude. At 10 miles, for example, it is decreased by as much as 40%, with further decreases at greater altitudes.

Wide range of applications

Min-Klad offers the missile and rocket designer a rich choice of heat-control possibilities. It may be used for a part that must insulate, yet have the structural advantages of plastic. Where requirements call for a scuff- and erosion-resistant insulating surface . . . or for a good adhesive bond between Min-K insulation and other surfaces. Or, it may be used to control high transient temperatures! For high heat capacity of asbestos-reinforced plastic combined with the low conductivity and heat capacity of Min-K result in a product that provides minimum heat transfer under transient conditions.

Min-Klad is now being tested for approximately two dozen missile and rocket designs. Why not investigate this new material for your present thermal requirements? Upon request, we'll be pleased to send you a sample of the material along with detailed technical information. Write Johns-Manville, Box 14, New York 16, New York. (Ask, too, for information on Min-K insulation and the new aviation insulation brochure IN-185A.) In Canada: Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

NEW COMANCHE 250 taxiing past KC-135A jet tanker points up how military aero clubs are building up modern private plane fleet.

USAF Clubs Boost Lightplane Markets

By Erwin J. Bulban

Rapid growth of aero clubs in the U.S. Air Force, encouraged by enthusiastic support from high echelons, not only is providing an important morale-building factor for service personnel, but also has developed into an important market for the business aircraft industry.

Also evident is a trend toward greater utility of the airplane by the growing number of Air Force club members, with attendant purchase of high-performance equipment to supplement aero club training vehicles. Starting out as a more or less local leisure-time activity for fun and relaxation, the military aero clubs are developing a hard core of people, many of whom have never flown in a lightplane before, with the desire to use the private plane as a normal form of private transportation for traveling and vacation.

SAC Aero Clubs

Detailed figures are not available on the over-all use of private and business type aircraft by club members at the numerous U.S. military installations, but some striking guidelines are afforded by a look at the organizations being developed at USAF's Strategic Air Command bases here and abroad.

Aero clubs are now established at some 50 SAC bases in the U.S., Spain and Labrador and their membership rolls total approximately 3,500 military and civilian personnel attached to these stations operating some 250 light aircraft of all types.

Each of the Command's aero clubs is directed by a board of governors and the president of each club is a representative to the SAC Aero Club Assn. which meets periodically to report on club programs and to help in formation of new clubs.

The annual meeting of the association also is attended by manufacturers of club-type aircraft and equipment makers, who display their products.

During the annual Aero Club Assn. meeting at Offutt AFB in September, a representative of Champion Aircraft, Inc., noted that some 15% of the company's total sales in the past year had been to SAC aero clubs. The next annual association meeting is scheduled in December at Barksdale AFB, La.

COL. M. E. WHITE heads aero clubs.

Largest of the organizations is the pioneering operation at Offutt AFB, Omaha, Neb., headquarters of Strategic Air Command. Formed in 1950 with the enthusiastic support of Gen. Curtis E. LeMay, then commander of SAC, the Offutt Aero Club began with a single Piper Super Cruiser. Today it operates 17 light aircraft, has some 300 members and expects to reach about 400 in a month, according to Col. Maynard E. White, president of both the Offutt Aero Club and of the SAC Aero Club Assn. Col. White credits the aero clubs with being a "tremendous asset" to any SAC base and states that they are a major factor in occupying the spare time of their personnel and in maintaining their interest in military careers.

Approximately half the Offutt aero club's members are officers, of whom half are rated pilots, the others being rated observers and navigators. The other half of the members are enlisted men and civilians attached to the base. Approximately 20 of the members are civilians, including seven women.

Membership rules are kept to a minimum and any officer, airman, civil

ARC's LATEST CONTRIBUTION TO AIR TRAFFIC CONTROL

Control Unit For Type 210

THE 360 CHANNEL TRANSMITTER-RECEIVER TYPE 210

As air traffic increases in volume, the question of safe and efficient control becomes more and more important. A vast increase in the number of assigned radio frequencies has been required in order to facilitate air-ground communications.

Only a few years ago pilots could operate with 10 or 20 channels. Later frequencies were increased to 80 or 90. Plans now call for 360 frequencies — enough to meet the need for years to come. In view of this channel increase, ARC now offers an all-channel, flight proven transmitter-receiver (Type 210 Transceiver) covering all 360 channels. The powerful 15 watts guarantees optimum distance range and the knifelike selectivity assures freedom from adjacent channel interference. Provision has been made for the selective use of single or double channel simplex. In the former, both reception and transmission are made on the same frequency; in the latter, transmissions are made on a frequency 6 megacycles higher than the receiving channel. There is no wait between receiving and transmitting for re-channeling.

This is ARC's latest contribution to air safety. Ask your dealer for a quotation to include a single or dual installation, along with other units of ARC equipment listed below.

Meets the CAA'S TSO C-37 and C-38 Category A

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service employe or dependent is eligible to join on payment of a $10 initiation fee. Aero club members pay $3.50 monthly; family membership dues are $5 a month regardless of the family's size.

Flying fees vary depending on the type of airplane. For example at the Westover SAC Aero Club, Westover AFB, Mass., dry prices (including oil) for the Cessna 172 are $4.50 an hour, for the surplus Beech T-34A trainer, $4; for the Champion Tri-Traveler, $3.50 and for the Piper Comanche $6.50 an hour.

The pilot pays for fuel at the time of fueling. Instructor's fees are $3 an hour. Payment is by means of bills mailed to each member on the first of each month and includes all flying and dues, payments being made to the club treasurer.

Practice Areas

All licensed pilots are permitted to operate from base runways, student pilots being flown to nearby practice areas to get their experience. Ground school is held on the base in the evenings and includes use of slides and tape recordings. Many SAC aero club members have started with no flying experience at all and progressed to Federal Aviation Agency-certificated instructor ratings and some members are youngsters who are permitted solo as soon as they reach the age of 16.

Flight instruction at the bases is handled by off-duty SAC pilots who are FAA-rated instructors. Maintenance is by licensed aircraft and engine mechanics among base personnel. Commercial civilian instructors are also utilized.

Club members are permitted to use the airplanes for trips; the length of time depends on the club's status. At Offutt AFB the airplanes may be taken for up to 30 days; at Westover AFB cross-country flight length is limited to 15 days. The minimum charge for an airplane on trips is $2 a day.

High-Performance Aircraft

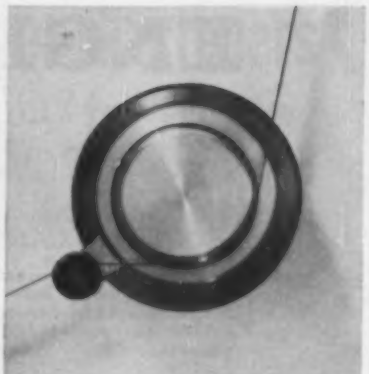
Introduction of high-performance types such as the Piper Comanche has been responsible for a sharp increase in aero club interest in the command, according to Col. White, particularly among rated military pilots who are more inclined to be interested in using a modern lightplane with good cross-country characteristics than in the lower-performance trainer types. At Offutt AFB, for example, which has four Comanches, the club is programing these for 60 hr. a month and expects them to be used at least 80 hr. a month. The Offutt club will probably log more than 8,000 flying hours this year, Col. White estimates.

Aware of the trend toward high-performance lightplanes, Col. White and a committee of officers from SAC aero clubs visited lightplane manufacturers last year to evaluate the available types and finally decided upon the Comanche. Piper cooperated to the extent of jumping over its own dealers' priorities for demonstrators and assigning the 35th and 36th airplanes on the line to a SAC aero club purchaser, who bought the airplane out of credit union funds.

Major factors in picking the Comanche over similar types were low initial costs and low operating cost per mile, according to the officers conducting the evaluation, in addition to factors such

French Army Orders STOL Liaison Plane

French Army has ordered 150 new Nord 3400 two-place liaison aircraft for service in Algeria. Short takeoff and landing aircraft is fitted with double-slotted flaps, also has leading edge spoilers, permitting takeoffs in approximately 100 yd. Devices also provide good handling characteristics even when flying at 44 mph. Powered by a six-cylinder inverted Potez of 260 hp., Nord 3400 has cruise speed of 125 mi., range of approximately 600 mi. Gross weight is approximately 3,000 lb. Tandem rear seat swivels 360 deg.; rear portion of cabin transparent area overhangs fuselage so that observer can look almost straight down. A door the length of the cabin permitted easy stowage of a litter. Up to 220 lb. of armament can be carried under the wings.



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Magnetic recording has reached the point where a better tape, by itself, can significantly improve the performance of your equipment. Anticipating this, Ampex has developed its Instrumentation Tape to assure the highest capability that the state of the art requires.

Precision tape reliability comes principally from the properties of its coating. And Ampex combines oxide preparation and careful coating techniques with the exclusive Ferro-Sheen process to produce the smoothest, most cohesive, most uniform of precision tapes. The result is measurably higher signal-to-noise ratios, and much less tape wear.

This, with its squared-up hysteresis curve, makes Ampex Instrumentation Tape ideal for all recording systems: direct, FM-carrier, PDM, and NRZ-digital.

Ampex Instrumentation Tape is available on hubs, NAB-type or die-cast magnesium - alloy Precision Reels. Widths of ¼", ½" and 1" are standard on either Mylar* or acetate base, in the following lengths, reel diameters, and base thicknesses:

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7"	1800	1250
10½"	3600	2500
14"	7200	5000

*DU PONT TRADEMARK

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Experience with antenna design and development in microwave, UHF and VHF regions. Should be familiar with antenna theory transmission line principles and associated measurement techniques.

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To evaluate servo and guidance systems for missiles. Dynamics stability loads and aeroelasticity.

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MINNEAPOLIS ★ DAYTON ★ CINCINNATI ★ DENVER ★ MILWAUKEE ★ SAN FRANCISCO ★ PHILADELPHIA ★ BOSTON ★ SALT LAKE CITY ★ CLEVELAND

as styling, cabin room and baggage capacity. The tendency to pick a Lycoming engine-powered type was also pertinent because of SAC aero club operating experience which indicated that this type of engine had twice the operating life between overhauls compared with competitive types and also a considerably lower overhaul cost, AVIATION WEEK was told.

With a continued number of Comanches going into aero club activities, members are extending their trips; at Offutt AFB they range into Canada and Mexico. A recent two-Comanche excursion from Offutt carried six generals and a lieutenant colonel on a ringneck pheasant hunting expedition into South Dakota.

Club memberships are transferable in case personnel move to another base; a paid-up dues receipt and membership card is all that is necessary. In the event a member goes on extended temporary duty, he is placed on inactive status and continues to pay dues, but on a reduced scale.

Clubs maintain high safety standards: chief instructor, instructor pilots or designated check pilots at each club conduct all checkout flights in each airplane and check pilots are inspected by the chief pilot prior to becoming a checkout pilot and are subject to rechecks. Check flights at Westover, for example, are conducted when any pilot has not flown the airplane in 30 days. He is required to make three landings prior to carrying passengers. If the pilot has not flown the airplane in 60 days, the field check includes a minimum of five solo takeoffs and a corresponding number of landings.

Night flying checks are given if cross-country flights will encompass such a requirement. A night flying check includes a 150-mi. cross-country flight with an instructor. Clubs have a flying safety board which includes the base flying safety officer and other qualified club members.

Lycomings to Power De Havilland Heron

Takeoff, loading and cruise speed characteristics of the four-engine de Havilland Heron executive transport are expected to be substantially improved with installation of 340-hp. geared and supercharged engines in place of standard 250-hp. de Havilland Gipsy Queens, a modification engineered by Vest Aircraft de Mexico for Banco Nacional.

Primary purpose of the conversion program, the modification company explains, is to provide the Heron with improved takeoff characteristics from high altitude airports in Mexico. According to Banco Nacional pilots, the Heron at gross weight of 13,500 lb. took

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• IN ALUMINUM
• IN MONEL

Where you need the strength of a solid rivet—in those impossible, blind installations—the new Cherry 3/32" Self-Plugging Rivet is the answer.

These Cherry miniature self-plugging rivets are now available in the industry-proven Cherry High Clinch configuration. Ideal for delicate installations in thin sheets with no damage to surrounding material.

A complete line of Cherry 3/32" Hollow Pull-Thru rivets is also available with either universal or 100° countersunk head.

For technical information write to Townsend Company, Cherry Rivet Division, P.O. Box 2157-N, Santa Ana, California.

*Patents Issued and Pending

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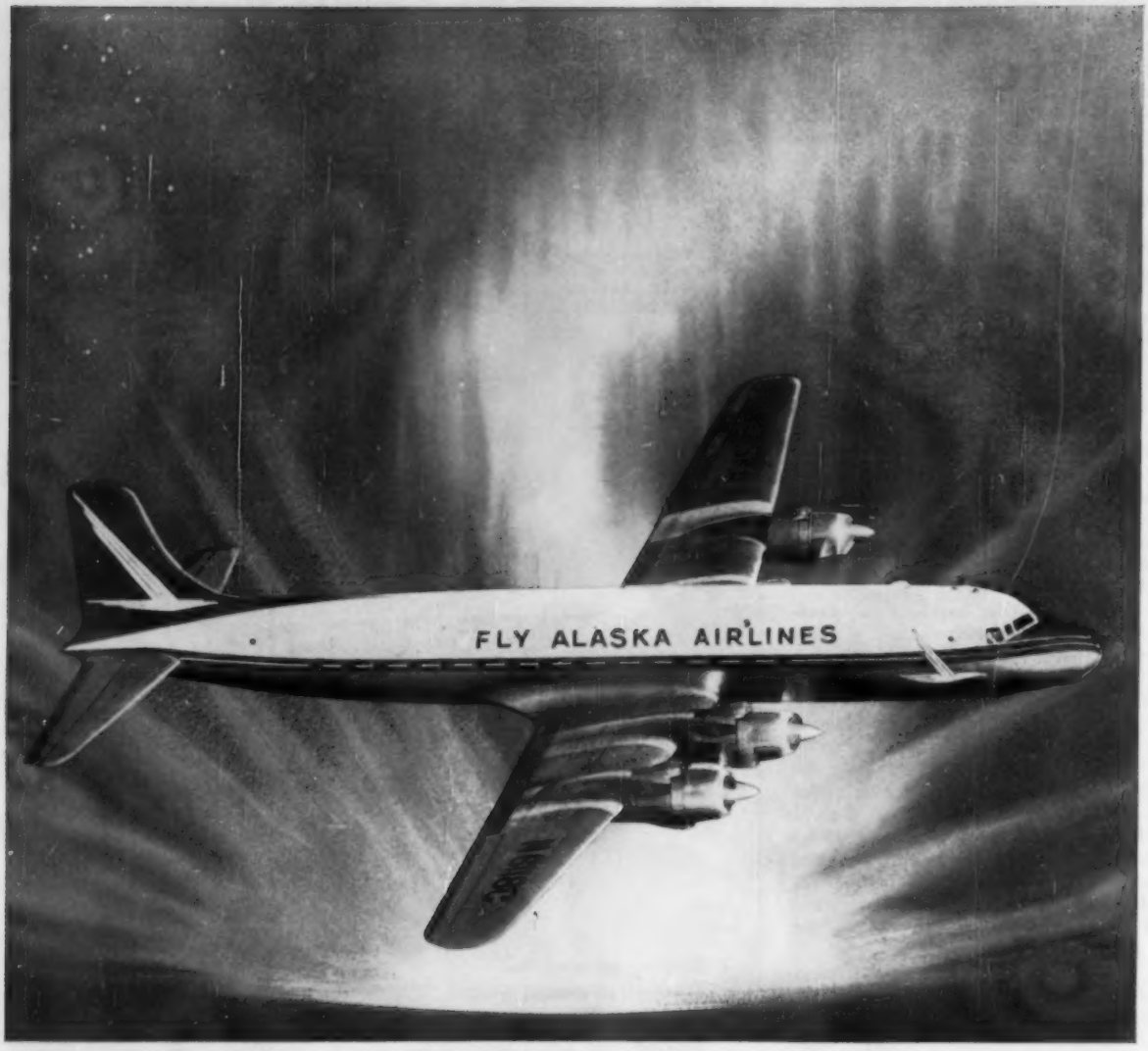

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Maintenance Chief George Sindt watches Mechanic Charles Murrill service an AC Spark Plug with the new AC Vibrator Cleaner.

Maintenance Chief George Sindt offers this information, "Talk about extreme operating conditions . . . Alaska has them! Extreme weather—extreme temperatures—extreme altitudes call for supreme reliability! We have found that AC 281 platinum electrode spark plugs in our DC-6's deliver pluses in economy . . . fewer unscheduled removals due to fouling . . . faster starts to conserve fuel . . . and no condensation problems caused by temperature changes!"

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Van Dusen Aircraft Supplies, Inc.: Chicago, Illinois; Minneapolis, Minnesota; Teterboro, New Jersey; East Boston, Massachusetts; Alexandria, Virginia; Richmond, Virginia; Miami, Florida.

First Photo of Cessna Model 210

Cruise speed of 190 mph. is indicated by results of nearly complete flight test program on new Cessna 210 four-place business plane, which retracts its tricycle landing gear completely into the fuselage. Cessna expects to get Federal Aviation Agency type certificate and production approval this month, will officially unveil the airplane to the public in September. Powered by a fuel-injection Continental 260-hp. engine, price of the plane will not exceed $22,500 for a standard-equipped model, Cessna states. Indications are that the 210 will be in competition with Piper's low-wing Comanche 250, standard version of which is priced at $18,995.

more runway for takeoff than a Douglas DC-7 at Mexico City. The field is 7,400 ft. above sea level.

Cruise speed is also expected to be increased from 180 mph. to better than 200 mph. and one-engine-out takeoff characteristics also will be improved. Takeoff gross weight will be increased to 14,500 lb. with the new Lycoming GSO-480-B1A6 powerplants.

Conversion cost of approximately $90,000 is expected to be less for future installations because of experience gained from initial modification.

Bendix Warns Users On Counterfeit Valve

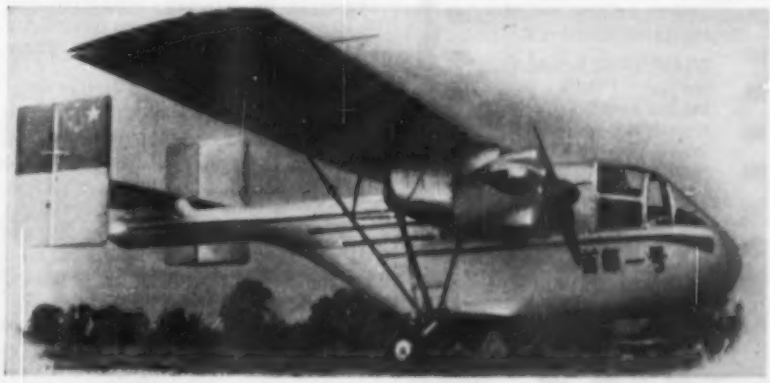
Counterfeit duplicates of a Bendix Pacific Division lever-operated power brake valve allegedly have been found in circulation by the manufacturer, who is warning users and distributors that it will not furnish spares for overhaul of these units and will not assume any liabilities in event of malfunctions or failures of the bogus item.

Not only are the brake valves duplicates of Bendix Pacific Division's item No. 405146, but the alleged counterfeiter also has placed both Bendix part numbers and Bendix-Pacific nameplates on the item, according to the original manufacturer. Bendix-Pacific, in letters to distributors and manufacturers notes that these bogus valves have been discovered fitted inadvertently on Aero Design Commanders serial numbers 593 through 710.

Bendix-Pacific advises that the alleged counterfeit valves can be identified from its own part by the blue anodized casting body. Bendix-Pacific Part No. 405146 is finished in a black wrinkle paint.

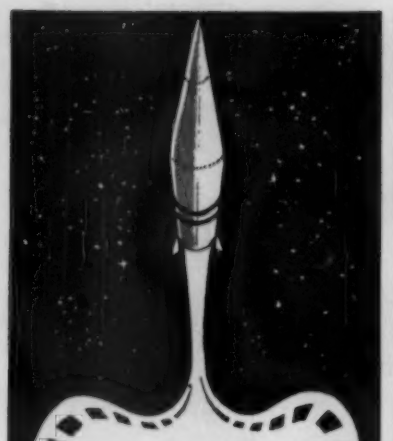
Following notification of the situation by Bendix-Pacific, Aero Design & Engineering Corp. agreed to notify Federal Aviation Agency of the existence of the alleged counterfeit and also to send a mandatory bulletin to all Commander distributors to remove the Bendix-Pacific nameplates from the bogus valves installed on their aircraft.

Bogus parts have long been a problem to operators and overhaul facilities working with surplus aircraft—in some cases the parts being reworked surplus unapproved items.



Red Chinese Build An-14 Transport

Red Chinese version of An-14 Pchelka (Little Bee) light transport was reportedly built in Peking in 68 days. Aircraft is designated Capital 1 and carries eight passengers.



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INDIANA GEAR'S factory remanufactured Sikorsky S-51 is displayed on the ramp at the recent roll-out of HSS-2 twin turbine ASW helicopter. The Indiana Gear ship is dark gray on the lower sections and light gray above and has a band of high visibility red.

Sikorsky Delivers Rebuilt S-51 To Indiana Gear Works Airfleet

Stratford, Conn.—Indiana Gear Works is the first corporation to take delivery of a Sikorsky-rebuilt S-51 helicopter as part of a small S-51 conversion program under way at Sikorsky Division's overhaul center here.

Size of the program depends in large measure on the availability of aircraft from the military, which has not been great. First S-51 rebuilt by Sikorsky went to the State of Connecticut (AW Dec. 10, 1956, p. 111) but was taken largely as a prestige measure in its home state. The military conversion program began to be seriously considered last year and the first one was delivered a few weeks ago to the State of Pennsylvania.

Price of the conversion is $45,000—not including accessories. For this, the customer is to receive what amounts to a zero-time airframe, engine and rotor system.

The surplus military S-51s are torn down at the overhaul center and all parts inspected. Those which meet new aircraft standards are retained and the others are replaced.

Indiana Gear, a major supplier to Sikorsky, will add the former Navy HO3S-1 to its fixed wing executive fleet which consists of a Douglas DC-3 and a Beech Bonanza. Indiana Gear has two plants at Indianapolis, Ind., and the helicopter will be based at Weir Cook Municipal Airport. The company has not yet settled on the actual detailed operational role of the helicopter, but it is certain to be used in shuttling plant personnel and visitors from the airport to the plants or between plants. The farthest plant is about 15 mi. from the field. General

Safety Award

Deadline for nominations for annual Business Flight Safety Award presented by Women's Aeronautical Assn. of Kansas is drawing to a close (May 1) and industry sources report that committee would like to see many more entries than have yet been submitted.

WAA award is one of year's highlights in review of business flying activities covered during National Business Aircraft Assn.'s annual forum, which this year will be held in Minneapolis, Minn.

WAA asks that names of nominees and summary of their activities in promoting business flying safety be forwarded in time to meet deadline to: Women's Areonautical Assn. of Kansas, P. O. Box 1676, Wichita, Kans.

Past recipients include: John P. Gaty, Beech Aircraft (1955); Jesse W. Stonecipher, University of Illinois (1956); and C. E. A. Brown, Ohio State Aviation Director (1957).

public service operations such as search and rescue also are contemplated.

Another but less certain possibility includes chartering to outside customers as a means of defraying the cost. The company is developing a hydrojet-powered boat and may test it in the Colorado River this year; the helicopter might be used to supply the test party.

Indiana Gear has taken the helicopter on a lease-purchase arrangement on a four-year basis. Sikorsky, however, is not eager to carry the financing itself on such sales.

Company Service

Provision is made for dual controls in the ship and the company's chief pilot, Max Jobst, was here last week for checkout. Jobst said that Indiana Gear's own mechanics would handle routine service and checks, but that the S-51 would return to the factory for major overhauls.

The color scheme of the S-51 includes a 24 in. band of flame red high visibility paint at the mid-section and extending to and covering the tail rotor. The tub section is dark gray and the top light gray, the color scheme chosen by the customer.

Interior, done by Air Service, Inc., here, is compatible with the exterior color. The headliner and rear bulkhead of the cabin are a gray plastic fabric and the lining under the windows the same in red. Seats are gray cloth and carpeting is gray. All fabrics are either inherently fireproof or treated for fireproofing by Air Service.

Powerplant is a new Pratt & Whitney R985 Wasp, Jr. piston engine. The standard S-51 three-blade rotor system with metal interchangeable blades is used.

PRIVATE LINES

Mark II Learstars have been ordered from PacAero Engineering Corp., Santa Monica, one by Texas Eastern Transmission Corp., Shreveport, La., and one by Central Soya Corp., Ft. Wayne, Ind. Recent Learstar deliveries by PacAero include Mark Is to Island Creek Coal Co., Huntington, W. Va., and Walsh Construction Co., N. Y. C., bringing number of Learstars built to 43. . . . Current PacAero backlog is over $2.5 million including recent follow-on orders for Spraymat anti-icing installations on an additional 240 Aeroproducts propellers for Lockheed Electras, deliveries running through October 1959.

Finance plan for private aircraft radio and navigation gear, providing for 18-month payment period at approxi-

U. S. Business & Utility Aircraft Shipments

January 1959

Manufacturer and Model	No. of Units	Net Billings
Aero Design Model 500	3	$638,000
Model 560E	2	
Model 680E	4	
Beech E18S	3	$1,773,000
Bonanza	38	
Twin-Bonanza	4	
Travel Air	8	
Call Air Model A5	0	$9,000
Model A6	1	
Cessna Model 150	60	$4,679,000
Model 172	60	
Model 175	114	
Model 180	22	
Model 182, Skylane	98	
Model 310C	23	
Champion Model 7EC	4	$123,000
Model 7FC	9	
Model 7GC	10	
Colonial C-2 Skimmer IV	1	$24,000
Fairchild F-27/F-27A	3[1]	$2,500,000[2]
Helio H-295B Courier	N.R.	N.R.
Mooney Mark 20	17	$194,000
Piper PA-18	13	$2,356,165
PA-18-A Super Cub	23	
PA-22 Tri-Pacer	37	
PA-23 Apache	29	
PA-24 Comanche	65	
Totals	641	$11,296,156

[1] Delivered were 1 Model F-27 (Rolls-Royce—RDa. 6) and 2 Model F-27A (RDa. 7).
[2] F-27 totals represent direct factory sales at retail.
N.R.—Not reported.

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For the same characteristics in insulating tubing, specify Markel FLEXITE in Teflon.

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INSULATING TUBINGS AND LEAD WIRE

NORRISTOWN, PENNSYLVANIA

mately $15 per month, has been developed by Nova-Tech, Inc., Manhattan Beach, Calif., for purchasers of its equipment. Firm set up Nova-Tech Acceptance Corp. to handle finance plan.

Service operators belonging to Aircraft Electronics Assn. will hold their annual meeting April 30-May 1, at the McAllister Hotel, Miami, Fla.

Fiberglas Aero-Dyne spray tank, stated by manufacturer to produce 368 lb. of lift when aircraft is doing 90 mph., is going into production in 110-gal., 75-gal., or 60-gal. capacities and will be available for installation on Piper PA-18-A and Champion agricultural airplanes. Thin center section permits special cut-outs on special order, to permit passage of dust hopper outlet. Item is built by Dakota Aviation Co., Huron, S. D.

License agreement to produce Doman LZ-5 helicopter in Italy at price of approximately $100,000 has been negotiated by Doman Helicopters, Inc., Danbury, Conn., and Doman-Mediterranea, Rome.

Airlift of approximately four million pounds of cargo to build up and support a big oil drilling rig in Guatemala has been started using three surplus Fairchild C-82 Box Car transports each carrying 15,000 lb. Equipment is being moved from a portside field to a strip 110 mi. in the jungle. International Brown Drilling Co. is drilling the exploratory well for Ohio Oil Co. of Guatemala, Amerada Petroleum, Continental Oil Co. and Union Oil Co. of California.

Larger tanks, holding 47.5 gal. of useable fuel, have been approved by Federal Aviation Agency for Bell 47J Ranger helicopter. New tankage increases 47J's range by approximately 40%, the company reports.

Export of de Havilland-Canada civil Beaver and Otter single-engine utility planes during 1958 totaled 17 of the former type and 33 of the latter make of total civil deliveries of 25 and 38 respectively. Since deliveries of Beaver began, in 1948, de Havilland has exported 1,071 out of 1,290 delivered through 1958; including 850 L-20s for U. S. Army; since start of Otter deliveries in 1952, 271 have been exported out of a total of 299, including 188 for U. S. Army.

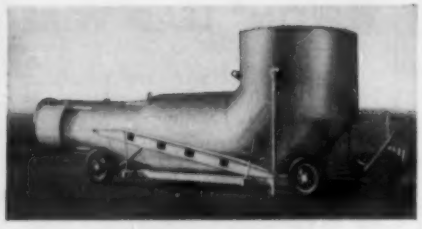
Expansion of facilities at University of Illinois Urbana Airport will be made using a $12,000 anonymous donation to build a T-hangar to house several executive aircraft. Current construction includes a $420,000 terminal building and control tower.

"Fly it yourself" tours of West Europe have been developed by Air France in cooperation with Comagnie Mondiale de Voyages, which will package economy air transportation via the French air line from U. S. to Paris and then arrange tour participants to use Piper Tri-Pacer lightplanes to visit key scenic areas. Each of four tours will average approximately $3,000 including transatlantic flight and first-class hotel accommodations.

Pilot proficiency training programs are conducted by 98% of business plane operators, a survey conducted by Flight Safety Foundation, N.Y.C., indicates. Return of 30% of questionnaires sent out by FSF also indicates: 52% of companies conduct their own training programs and use outside facilities as well; 38% use only their own programs and 10% use only outside programs.

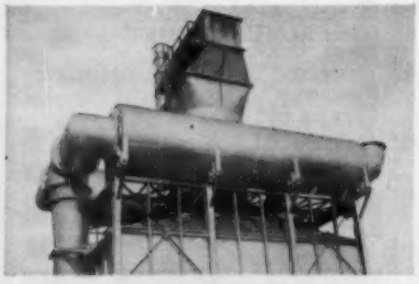
Lycoming engines with constant-speed propellers will replace DH Gypsy engines and fixed-pitch propellers in Australian-built DH Drover trimotor flying ambulances used by the Flying Doctor Service in that country.

QUIET FOR JETS



MAXIM PORTABLE JET SILENCERS

Model JEC-10 (shown) is designed specifically for the Douglas DC-8 and Boeing 707. This rugged unit affords a high degree of silencing — without using tie downs.



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Built to match your acoustical requirements. Units are engineered for future internal and external expandability — to protect you against obsolescence.

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EMHART

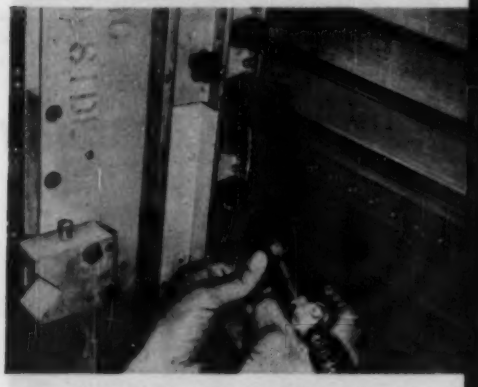
Sikorsky HSS-2 twin turbine engine anti-submarine warfare helicopter flies past rollout crowd in high speed run. Pilot's window, apparently not tightly fastened, blew out at the start of the flyby at the company plant at Stratford, Conn. The helicopter's engines are General Electric T58s (AW Mar. 30, p. 30).

Navy's HSS-2 Demonstrates Amphibious Capability

Tail first landing is made in the Housatonic river (left). Water handling characteristics are shown in turn (right).

HSS-2 hovers before touchdown on land (left). Split cabin door with steps in bottom section is visible (right).

THE HI-LOK AUTOMATIC FEED DRIVER, FITTED TO AN INGERSOLL-RAND AIR MOTOR, ASSEMBLES UP TO 200 COLLARS ONTO HI-LOK PINS WITHOUT RE-LOADING. ASSEMBLY RATE: UP TO 45 PER MINUTE.



HI-LOK IS BEING ASSEMBLED UNDER WING RIB IN EXTREMELY TIGHT QUARTERS USING A HI-LOK 20° RATCHET WRENCH ATTACHMENT AND KELLER AIR MOTOR.

HI-LOK IS BEING INSTALLED WITH LIGHTWEIGHT TOOLING IN PLANK SPLICE OF ELECTRA "WET" WING.

WRENCHING END OF HI-LOK COLLAR AUTOMATICALLY TORQUES-OFF WHEN DESIGN PRELOAD CONDITION IS ATTAINED DURING ASSEMBLY.

MINIMUM TOOL CLEARANCE CONDITIONS ON STIFFENERS IN WING FRONT SPAR ARE EASILY MET WITH HI-LOK ADAPTOR TOOLING COMBINED WITH INGERSOLL-RAND AIR MOTOR.

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The Hi-Lok, because of its collar torque-off feature to automatically obtain a preload consistent within ±10%, is installed quickly and quietly with standard high speed air drivers. Torque wrench inspection is eliminated.

Manufactured in standard and precision tolerances for interference fit hole conditions, Hi-Loks come in a variety of material combinations where temperature resistance, high strength and weight reduction are design factors.

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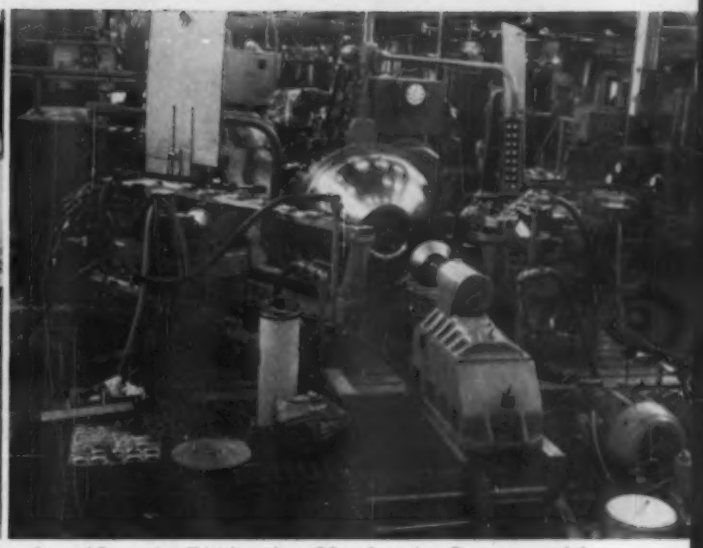
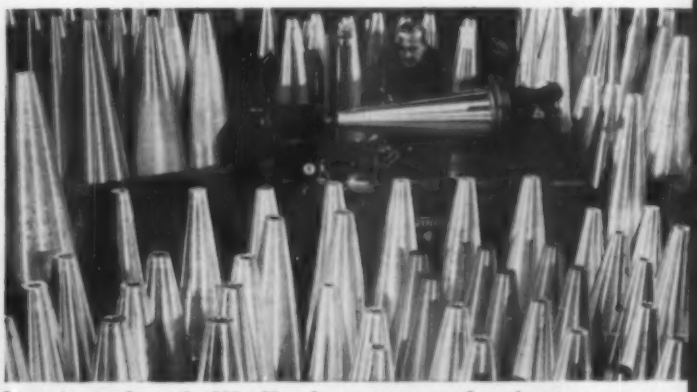


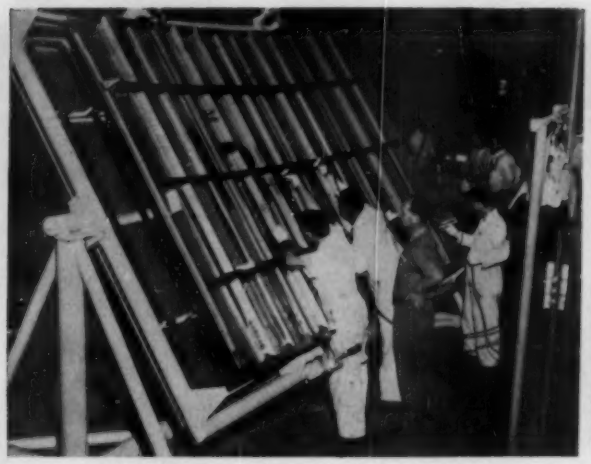
Five stages of Nike Hercules nose cone production at Stratford, Conn., plant of Lycoming Division, Avco Manufacturing Corp., are at left foreground, starting with flat bank; preform; first and second spin and finished spin. At right is a hydrospinning machine which has a capacity of up to 60 in. in diameter. Machine eliminates welded joints.

Lycoming Uses Nose Cone Spinning Technique

Flat blank is placed on hydroform machine (left) and, at center, now is ready for first spinning. Final spinning is under way at right; two hydraulically controlled work rolls at left foreground are diametrically opposed, ensuring a perfect round. Spinning also produces a fine microfinish. Cones are made of 6061 aluminum.

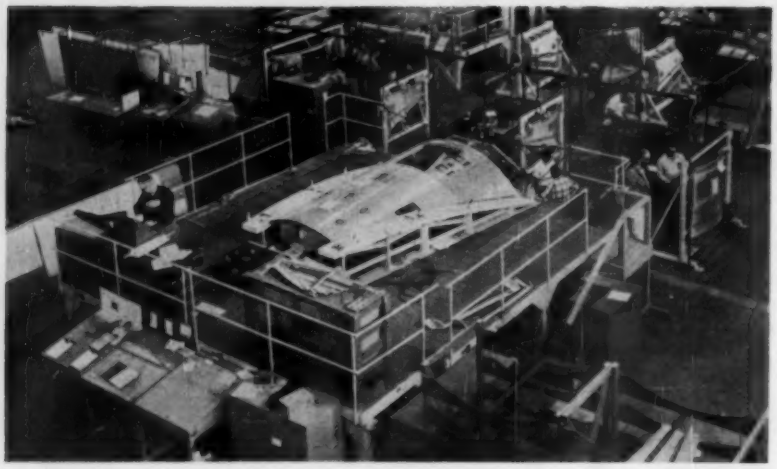


Lycoming produces the Nike Hercules nose cones under subcontract to Douglas Aircraft Co. At left, technician checks wall thickness, controlled to plus or minus .006. Final roundness check is made at right.



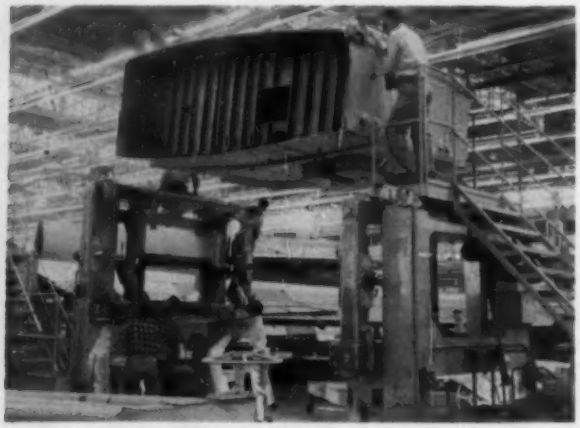
Sealant is applied (left) to the lower panel of a B-52G wing center section at Goodyear Aircraft Corp.'s plant in Litchfield Park, Ariz. At right, ribs, spars and panels are placed in position as the B-52G wing center section takes shape in a final assembly jig.

Goodyear Fabricates B-52G Center Wing Section

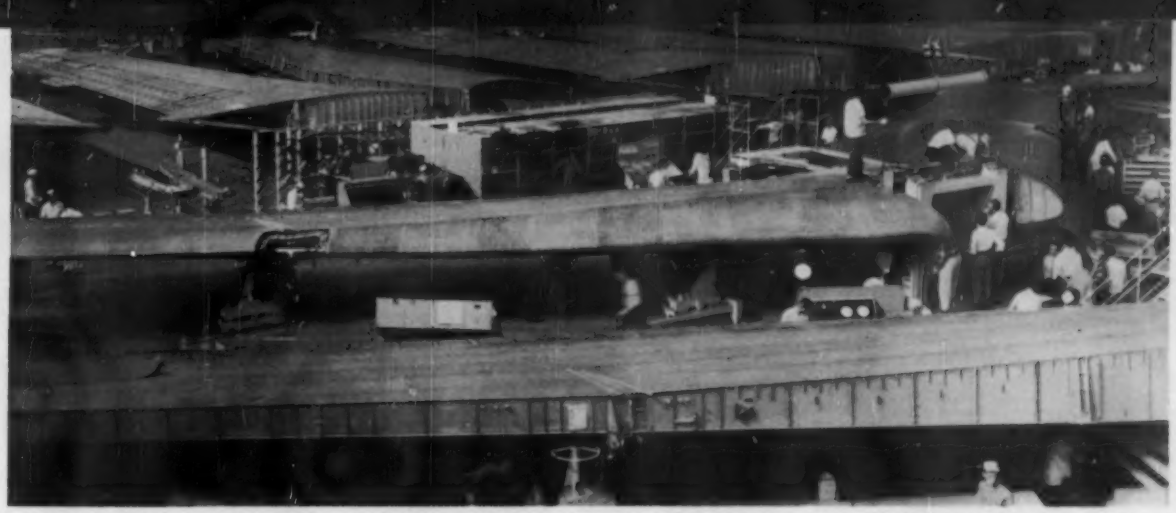


Final assembly of the top panel is above. Components that make up the top panel are adjacent to the final assembly jig where they are brought to be spliced in the fixture. When assembled, sections are pressure-tested and sent to Boeing's Wichita, Kans., division.

Wing center sections for Boeing B-52G missile platform bombers are fabricated by Goodyear Aircraft Corp. at Litchfield Park, Ariz. In addition to being a load-bearing structure, the center wing section serves as a portion of the fuel-carrying system. In predecessor bombers a leakproof rubber fuel tank was inserted between upper and lower wing panels since the light-gage aluminum-alloy skins flexed in flight to a degree that obviated use of sealant to form integral fuel tanks. The B-52-series bombers, however, have heavy-gage skin sections that are sufficiently inflexible so that integral tanks can be used, thereby permitting considerable savings in weight. The B-52G made its first flight Oct. 26 (AW Nov. 3, p. 32) at McConnell AFB, Wichita. The bomber will carry the North American GAM-77 Hound Dog (AW Mar. 30, p. 33) air-to-ground strategic missile mounted on a wing pylon. The B-52G is 157 ft. 9 in. long; earlier B-52s are 152 ft. 9 in. long.

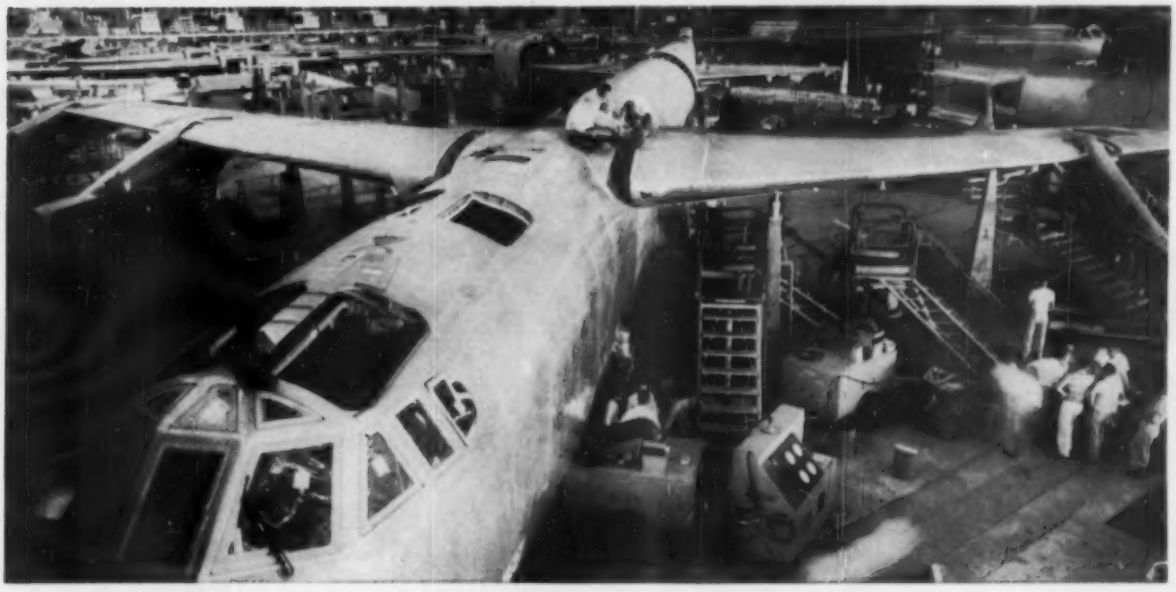


At Boeing's Wichita Division a center wing section is locked into a wing jig (left) that is located between the two main wing jigs. Another view of the center wing section (right) shows its relationship to the wing jigs as assembly of components begins.



The B-52G wing begins to take shape after the center section and the main wing sections have been loaded into the jig. Jigs and fixtures vary in size from bench devices for subassemblies to units that can turn a wing section over for access to bottom areas.

Completed wing section is about to be lowered to the B-52G fuselage (above). Size of the center wing section and the load that it carries is apparent. Fairings are installed (below) to enclose the space between wing and fuselage. The top panel which covers a portion of the center wing section is similar to the one shown in final assembly in the middle of the opposite page.



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Fairchild Girds to Recoup F-27 Loss

By William H. Gregory

Fairchild Engine & Airplane Corp.'s net loss of $17,435,761 in 1958 reflects a decision on the part of the company's new management to take its financial "bath" now on the F-27 Friendship turbine transport program to clear the way for profits on the program later.

F-27 losses written down in 1958 total $29 million and include $9.5 million in anticipated losses in 1959 and 1960. These loss projections are based on an ultimate sale of 100 airplanes. If total sales fall short of this, further write-downs would be necessary. Fairchild reports 67 firm orders for the airplane; 35 had been delivered at year-end to five airlines and eight corporate customers.

Underpricing is still a problem, though the original price was raised from $575,000 to $635,000. Another price increase is probable, AVIATION WEEK learned last week, but would be part of a product improvement program that would in effect provide a new package. Three stages of modifications involving interior redesign and wing refinement to produce a higher aspect ratio without lengthening the span could raise the airplane's maximum gross weight to 40,000 lb.

Such increases, however, raise still another basic problem: the market role of airplane. Installation of the Rolls-Royce RDa.10 2,660 eshp. engine in place of the RDa.6 or 7 now used could expand the airplane's passenger capacity from 36-44 now to 56. But Fairchild is concerned that this would remove the F-27 from the market it was designed to fit. Too large an airplane might be too hard for local service carriers to fill or too big for corporate requirements.

As for new sales prospects, Fairchild is aiming at the moment for the trunklines that have extensive short haul routes. It is pushing the F-27 as a complementary aircraft to the Lockheed Electra, for example, or to pure jets but also is finding the trunklines so involved in jet financing and transition they have little opportunity to discuss more distant plans.

Besides its problems with the F-27, Fairchild was hit at year-end by cancellations of the Goose diversionary missile and J83 small turbine engine. This resulted in the company writing down by $1,980,490 the $12 million engine and test facility it had built at Deer Park, N. Y., as well as the corporation's executive office building at Hagerstown, Md., so that the values of these would correspond to what the company expects to realize from their sale, which is planned. The two facilities are now carried on the books at $6,150,000.

Most of the executive office personnel has moved to the production plant at Hagerstown and lack of space there is reportedly all that is preventing completion of the move.

Fairchild President J. H. Carmichael, who was named to the post last December, said in the company's annual report that, "It would be a mistake, however, to consider these developments as indicative of a crisis of fatal magnitude in the company's activities."

He pointed out the company was a major subcontractor on the Boeing B-52G program, that other missile and aircraft development programs and an Army surveillance drone are under contract, and that the Stratos and Astronics Divisions had maintained a satisfactory level of business.

The Goose and J83 cancellations removed $50 million in prospective 1959 sales and this is reflected in Fairchild's backlog at year-end of $135 million, down from $170 million a year earlier. Of this backlog, 19% is in F-27 orders.

Despite the decisive role the F-27 plays in Fairchild's problems, the company recognizes that finding new military business is the most essential requirement for its survival, AVIATION WEEK was told. It has begun an appraisal of its capabilities and markets and evolved these concepts:

- **Sticking to medium size airplanes.** Fairchild doesn't see itself in the big airplane business and looks to the 75,000 lb. gross weight, 20,000 lb. payload class as the top.
- **Remaining in the drone field.**
- **Continuing or developing** VTOL or STOL/projects, including uses in emergency situations.
- **Improving space capabilities** initially at least in the guidance field based on the company's drone experience.
- **Building its engineering** capabilities.

The last is considered a vital necessity because of the growing trend of the military to buy technological capabilities primarily in contracting for advanced projects. This will not take the form of simply adding engineers but rather of hiring the right kind of engineers. One way open is to hire recognized leaders in technical fields.

No effort was made in the annual report to gloss over the fact that the company does have financial problems:

- **Net working capital** dropped from $20,151,274 in 1957 to $6,071,789 last year.
- **Bank loans** at the same time rose from $20 million to $30 million, though application of a $5,840,000 tax credit

Space Vehicle Costs

	Cost of Development	Cost per Unit After Development[1]
Existing Vehicles:		
Thor-Delta*	[2]	$ 2,500,000
Thor-Able	[2]	3,700,000
Atlas-Able	[2]	6,500,000
Juno II	[2]	2,250,000
Jupiter	[2]	2,250,000
Atlas	[2]	3,600,000
Vehicles Under Development:		
Scout	$ 6,300,000	$ 500,000
Vega	24,300,000	5,000,000
Centaur	36,200,000	7,500,000
Juno V	250,000,000	15,000,000
Nova engine	200,000,000	2,000,000[3]

[1] Without payloads.
[2] Developed under missile program.
[3] Engine only.
* Thor-Delta is a modified Thor-Able incorporating long coasting time capability. It uses the Thor as a first stage, Aerojet Vanguard engine as second, Allegany ballistic laboratory Vanguard engine as third stage.

Source: National Aeronautics and Space Administration.

PUMP PRIMERS

by
Arthur A. Nichols

"Who Says A Pump Can't Handle It?"

Designing and building special pumps to handle new materials or to solve unusual problems has been a major part of our business since 1926. That is when we produced our very first pump for the then-new rayon industry. Today, Nichols pumps are standard in the synthetic fiber industry for pumping rayon, acetate, celanese, nylon and other new fibres spun in synthetic fibre plants all over the world *(Fig. 1.)*

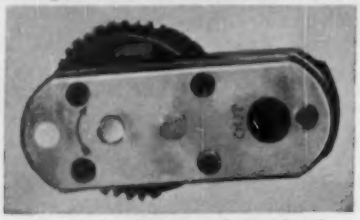

Fig. 1. Metering pump, designed and produced by Nichols.

Other materials now handled by Nichols pumps include: beverages in vending machines; molten lead in production equipment; lubricants for engines and gear boxes in helicopters and other aircraft; fluids for ship-borne and airborne hydraulic servo systems and coolants for high-flying electronic equipment. *(Fig. 2.)*

Fig. 2. Electronic equipment coolant pump.

Unusual problems solved by Nichols pumps include: saving weight and space by incorporating multiple pumping services in a single housing with a single shaft; tailoring pump configurations to meet specific performance and envelope-design conditions; minimizing turbulence and foaming of various aviation fluids at high altitudes.

This unique experience in industry wide pumping applications, combined with years of specialized development and production of pumps for aircraft, supercharger, missile, helicopter and electronic applications is available to help you handle new materials or solve unusual problems.

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NASA Estimates Project Mercury Costs

Washington—Budget estimates for Project Mercury, National Aeronautics and Space Administration's man-in-space program, during the 1959 and 1960 fiscal years total $128,411,200, including a 1959 supplemental request for $20.7 million. Here is a breakdown of program costs:

	Fiscal 1959	1959 Supplemental	Fiscal 1960
Scientific and technical studies:			
Human factors	$ 600,000	.....	.....
Range and recovery	100,000	.....	$ 300,000
Design studies of advanced systems	.....	.....	1,000,000
Prototypes and operational hardware:			
Capsules	11,500,000	$4,000,000	22,000,000
Boosters	21,861,200	16,000,000	27,700,000
Operations and technical services:			
Flight test operations	1,100,000	.....	9,500,000
Range and recovery	600,000	.....	3,000,000
Pilot training	.....	.....	500,000
Supplies, equipment, repairs, and alterations:			
Large scale and wind tunnel models	400,000	.....	3,400,000
Environmental and functional test equipment for capsules and components	500,000	.....	1,000,000
Data acquisition and handling equipment	300,000	200,000	300,000
Simulators and personnel equipment for human factor research and personnel training	150,000	500,000	500,000
All other items	550,000	50,000	800,000
Total	$37,661,200	$20,750,000	$70,000,000

after the first of the year cut this figure to $25 million. Fairchild has a revolving credit agreement with a group of banks allowing for a maximum of $30 million in loans, but this expires Sept. 30.

• **Net worth** dropped from $37,493,392 in 1957 to $20,057,631 in 1958. This cut the shareholders equity from $12.34 to $6.60– which compares with a market price in the $9 a share area.

• **Current ratio**, a measure of liquidity, dropped from 1.5 to 1 last year to 1.1 to 1. That is, for every dollar of current liabilities at year end, the company had $1.10 in readily realizable assets to meet them.

Fairchild's losses before the $5,840,000 tax credit were $24,447,761. The tax refund was received by the company in February and on the basis of a year-end audit a further credit of $1,172,000 was applied for.

Fairchild, which has deposits of $3,034,950 from F-27 customers, is carrying materials, labor and other costs incurred on F-27 commercial contracts on its balance sheet at $9,144,405. Under its previous accounting policy, Fairchild had carried its F-27 losses on a proportionate basis, applying it in segments on the individual airplane as it moved through completion. Its new system, in effect, writes off the total estimated loss on airplanes being built.

Fairchild will probably show another loss for the first quarter of this year. Carmichael forecast that the situation should improve after that and that the company ought to end the year in the black.

Bank loans are expected to be reduced to $15 million soon. The company believes its working capital has hit bottom and will begin to rise again this year and that it can begin rebuilding its net work. Sale of the two buildings would be helpful in the latter.

Fairchild stock reacted mildly to the bad news, though it did drop a fraction below $9 a share, which in the past has been a resistance point. The company feels its problems had already been discounted in the market since security analysts were aware last year that the company was encountering difficulties.

One interesting sidelight to this has been the acquisition by a large New York investment firm of a large bloc of Fairchild stock—about 200,000 shares. Actual ownership of the stock, which the investment firm holds in its name, is distributed widely among its customers and Fairchild does not feel this poses threat of a battle for control.

Sherman M. Fairchild, who was named chairman of the board at Fairchild last summer when it became apparent that the F-27 program was running into unusual delay, discussed in the annual report what steps management has taken to meet the financial crisis.

The board felt, at its meeting last

June, that in the absence of F-27 deliveries, costs must be mounting to a critical degree, he said. This is described as something of a guess, since starting costs on a complex project do not show up promptly under any conventional accounting system.

A special working committee of the board was created to investigate and Fairchild's accounting firm was instructed to provide a staff to provide an intensive cost study in a hurry.

Production Study

As a second step, the board began a study of the production difficulties, which centered about differing methods between European and American tooling and manufacturing. Fairchild had contracted with Fokker in Holland for its engineering of the F-27, but found this was tuned to flexible Dutch production techniques making use of highly skilled, relatively low cost master craftsmen available there than to the rigid requirements of U. S. mass production tooling (AW July 28, p. 31).

A third step was to reorient Fairchild's management toward commercial capability, represented by the appointment of Carmichael.

"The effect of these vigorous measures," Sherman Fairchild told stockholders, "which at best could be expected to yield only minimum benefits in so short a time, was rudely offset by a change in military strategic concepts which led to termination of . . . Goose . . . and the J83. When the government cancels a program such as the J83 in which it had invested more than $60 million of the taxpayers' money after encouraging your company to build a $12 million engine and test facility, a director is bound to be as astonished and depressed as any other stockholder.

"I will not attempt to paint a rosy picture of the past year or of the immediate future. Beyond the immediate future no one can see with certainty. . . .

"The company has been through a goodly number of major successes and its share of difficulties in the almost 40 years since I founded it. I have no less confidence today than I had in the worst days of its long history that it has a role to play in its industry, an important and profitable role."

To add to the company's problems, the Renegotiation Board has determined the company made $2 million in excess profits in 1953 and seeks a net refund of $400,000. The company appealed to the U. S. Tax Court for review but has provided for any necessary refund.

Northrop Corp. First Half Earnings, Backlog Increase

Northrop Corp. earnings for six months ended Jan. 31 totaled $3,144,704, or $1.97 a share. Earnings for the same period last year were $2,864,369, or $1.82 a share. Sales and other income for the first half of Fiscal 1959 were $116,042,409, compared with $125,524,168 for the previous year's first half. Backlog of orders totaled $264 million on Jan. 31, an increase of $22 million over the backlog as of July 31.

Douglas C-133 Cargomaster Production Line

Douglas C-133 Cargomaster turboprop transport awaits installation of its four Pratt & Whitney T34 engines; note engine container at lower right. Aircraft is shown on Douglas Aircraft's Long Beach, Calif., line. Nose radome has not yet been installed.

computing components from Librascope

New precision differentials with double-bearing pinions

Model	36	37
Pinions	2	2
Bearings per pinion	2	2
Shaft Type	hollow	solid
Shaft Size	1/16" ID	1/16" OD
Inertia	0.075 oz-in²	0.075 oz-in²
Max. breakaway torque	0.25 oz-in	0.25 oz-in
Max. backlash (minutes of arc)	7'	7'
Max. static load	6 in-oz	6 in-oz
Max. gear input speed	1200 rpm	1200 rpm
Working Circle	1.000"	1.000"
Length	0.980"	0.980"
Weight	3 oz.	1.5 oz.

LIBRASCOPE's new Model 36/37 differential with two miniature precision bearings per pinion provides greater accuracy and less backlash than previously available models. Can be ordered with either a hollow or solid shaft. The hollow shaft version (Model 36) employs a unique method of internal shaft clamping which prevents marring of the shaft and reduces overall length. A new and superior method of attaching side gears is also provided.

SEND FOR DATA SHEET 36-37

Angular to lineal conversion with sine-cosine mechanism

Model	43	44
Accuracy	0.3%	0.15%
Max. breakaway torque	0.1 oz-in	0.1 oz-in
Max. recommended speed	100 rpm	100 rpm
Max. recommended load on pin	4 oz.	4 oz.
Throw	½"	1"
Diameter	2"	2½"
Weight	2.0 oz.	2.5 oz.

The LIBRASCOPE Sine-Cosine Mechanism accurately converts angular rotating motion into lineal sine-cosine movement. Instantaneously solves problems of changing variables involving vector components, range and bearing computation, flight computation, and many other trigonometric functions.

SEND FOR DATA SHEET 43-44

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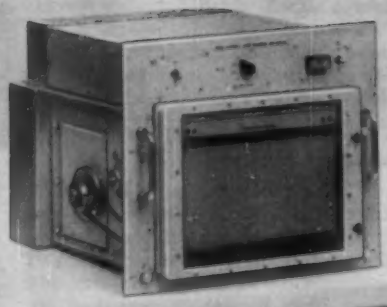

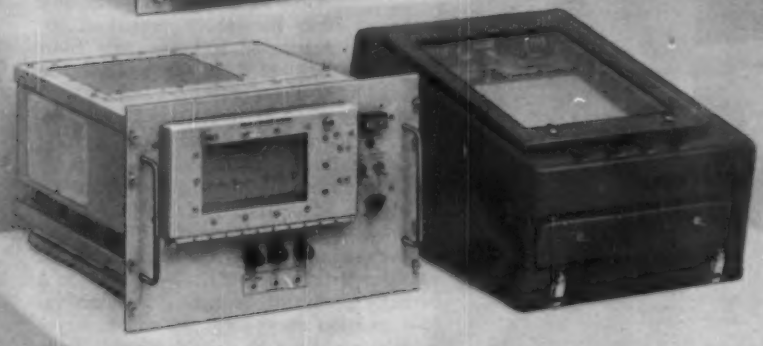

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Bell Tests Obstacle-Information Radar

By Craig Lewis

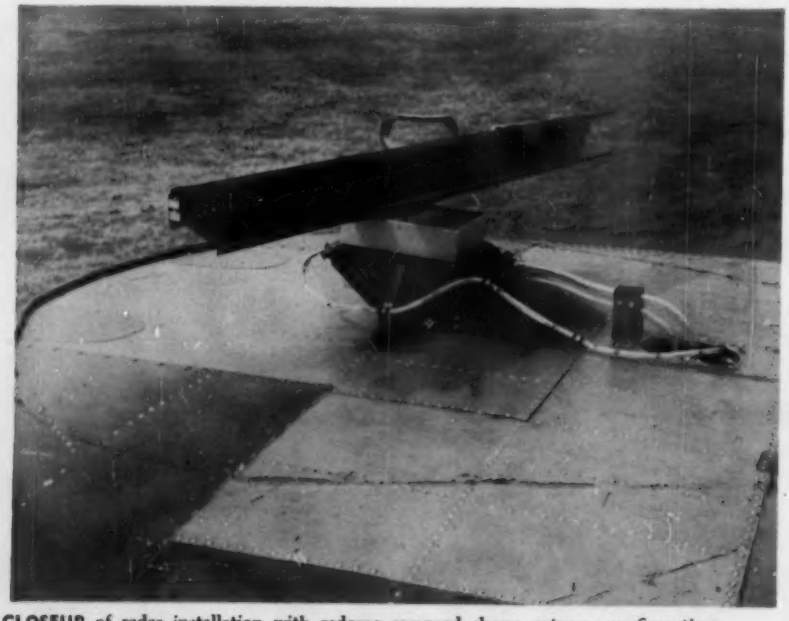
Ft. Worth—Bell Helicopter Corp. is testing a new terrain clearance and ground mapping radar here which fills a gap in helicopter instrument flight capability by providing obstacle information for operations close to the ground.

The radar was developed for the Army-Navy Instrument Program (AW Nov. 4, 1957, p. 96) by Bendix-Pacific Division of Bendix Aviation Corp. It is one of a series of sensors Bell will eventually combine to produce an integrated all-weather instrument flight system for helicopters.

Bendix radar will provide navigation information for the system and will give it an obstacle sensing capability. Ability to avoid obstacles in all-weather conditions is currently a gap in helicopter instrument flight systems, and adding this capability will permit all-weather military operations between mountains, in canyons and in similar low altitude situations.

Radar system is designed to operate over a 10 mi. range for ground mapping and up to five miles for obstacle avoidance. The system weighs 75 lb.

RADOME covers Bendix-Pacific radar mounted on Bell RH-2 (HU-1 research helicopter).



CLOSEUP of radar installation with radome removed shows antenna configuration.

Target Location

Bendix system is a Ku-band pulse radar using phase comparison for accurate location of targets in the vertical plane. The reflected radar signal is received by two slotted arrays, detected by dual mixers and amplified by dual IF channels. The signal is then phase compared and up-down information derived. The unique antenna is 3 in. wide and 40 in. long. Bendix says the narrow dual slot array device is less than one-tenth the area of an equivalent resolution parabolic dish-type antenna. The system's 0.1 microsecond pulse width and one degree azimuth beam width provides high resolution.

The antenna arrays consist of 83 inclined shunt slots in the waveguide. Azimuth beam width is one degree, and elevation beam is 0.5 deg. for switching. Elevation beam width is produced by two vanes which form a horn with a vertical aperture of less than 3 in. Phase-limiting antenna provides a signal which furnishes terrain clearance information through a new phase comparison technique. The system includes two amplitude-limiting phase-tracking IF amplifiers and a phase detector.

Antenna Mounting

The antenna is mounted in a radome on top of the cabin and forward of the rotor mast. Drive mechanism rotates it through a 360 deg. scan at 60 rpm. Ground mapping information comes from the whole scan, but obstacle information is taken only from the 40 deg. forward segment of the scan.

This segment is limited by the requirements of the display, not by radar capability.

Mounting the radar antenna on top of the RH-2 (HU-1) helicopter introduces some interference in the rear 20-deg. segment from the main and tail rotor structures, but it is superior to a belly mounting because it provides information on the ground and in hover that could not be provided from a belly position. And putting the radome under the helicopter would also make it vulnerable to ground damage.

Receiver-transmitter and power supply for the system are housed in a case

that is 20 in. long and less than 11 in. wide. The transmitter operates at 50 kilowatts, with peak power at 16,500 megacycles and a repetition rate of 2,400 pulses per second. Pulse width is 0.1 microseconds. Input power is 28 volt direct current, 115 volt, 400 cycle three phase, and this requirement can be met by available power on helicopters and small fixed wing aircraft.

Bell is now using interim displays to test the radar system's capabilities. One is a monochromatic cathode ray tube display that is used for obstacle information only, and the second is a cathode ray tube display that shows both navigation and terrain clearance information. This second display shows terrain features in red and green. An obstacle that is below the centerline of the antenna is green, while obstacles above the centerline are red, indicating possible danger.

The optimum set of displays for the integrated flight control system have not yet been determined, but the Bendix radar will present roughly the same information on the optimum displays that it shows on interim displays.

Navigation Display

Eventually the system will have a navigation display involving the Plan Position Indicator principle used in the interim test display, perhaps with the addition of an overlay. This optimum display will use the Bendix radar to map the ground for navigation purposes. Utility of the two-color scheme to tell the pilot whether terrain features are potential hazards is being explored.

Obstacle information from the forward segment of the radar scan will also be presented on the vertical flight control display which the pilot will use in the integrated system to fly the machine in instrument conditions. This display will probably be based on an optical system developed by Autonetics Division of North American Aviation.

The Autonetics display is a large lens which permits everything to pass through a narrow wavelength in the green section of the light spectrum. The lens catches the flight display projected in this wavelength and presents a grid pattern picture to simulate the ground.

The display presents its pattern with visual depth so that, unlike cathode ray tube displays, a pilot's eyes don't have to adjust from close to distant sight in the transition from instrument to contact flight.

Obstacle information will be presented on this vertical display at the proper angle and distance so any object will have the correct range perspective. The antenna is deliberately unstabilized

Price Cutting vs. Economy

Competition can be the life of progress; indiscriminate price cutting, the death of it.

One of my favorite stories concerns the farmer who had to cut costs in order to compete successfully in the market place. He arbitrarily cut the ration of oats consumed by his mule each day. This he did over a period of time and, although the mule "kicked" about it, the farmer continued to demand a full day's work from him. The economy of the reduced rations pleased the farmer, but the mule died of malnutrition.

Even when customers "kick" about prices, manufacturers must avoid, at all costs, the mistake of indiscriminate price cutting to remain competitive. It is our responsibility to find and eliminate the sources of waste in our operations in order to hold prices down. We must also adopt all possible improvements in engineering, manufacturing and marketing techniques. This approach is the only feasible means of providing improved products at lower cost to the ultimate consumer.

In the current race for technological break-throughs occasioned by the advent of the Space Age, we component manufacturers must design and produce, within a realistic budget, the required equipment at a reasonable price. This "price" cannot be arrived at by arbitrary price cutting if we are to remain solvent.

We must convince buyers and contracting officers that: 1. A reasonable profit is necessary to perpetuate a business. 2. Prices must allow for equipment replacement and obsolescence. 3. Prices must support a reasonable Research and Development effort.

If we fail in this task, it is conceivable that the buyer will awake some fine morning to find that the mule is dead.

George J. Pandapas
President

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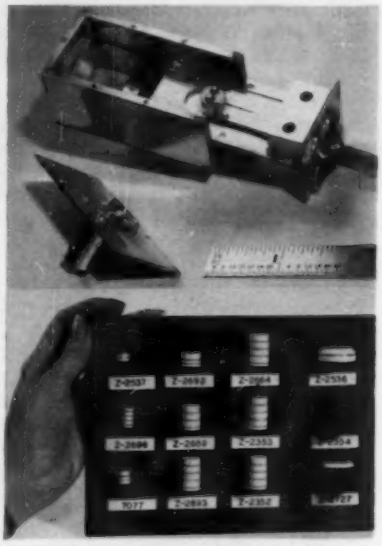
Divisions: Connors Steel, Delta-Star Electric, Diaston, Forge and Fittings, Leschen Wire Rope, Mouldings, National Electric, Refractories, Riverside-Alloy Metal, Thermoid, Vulcan-Kidd Steel, H. K. Porter Company (Canada) Ltd.

so the obstacle blip will move with the display pattern, rather than remaining stationary in the display.

The radar system has fixed range scales of 9 mi., 3 mi. and ¾ mi. It also has a flexible range feature tied to altitude in which radar range scale decreases from 3 mi. to ¾ mi. as altitude decreases during a landing.

With this "rubber range" feature, the pilot has a broad picture of the area when flying at altitude and a large picture of the immediate area when he is at treetop level or landing.

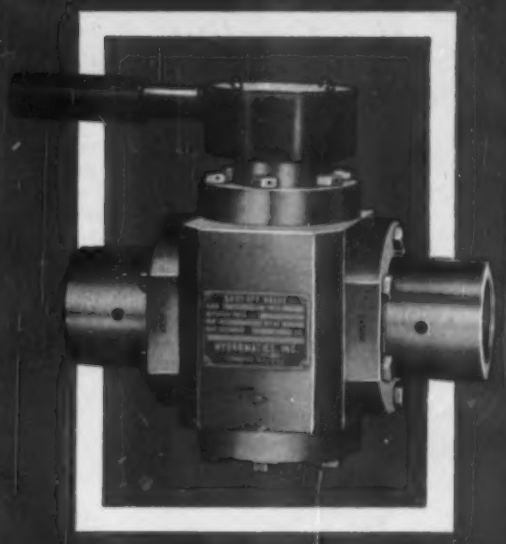
In a demonstration at the Bell plant here with the antenna rotating about 10 ft. from the ground, the interim display clearly showed helicopters

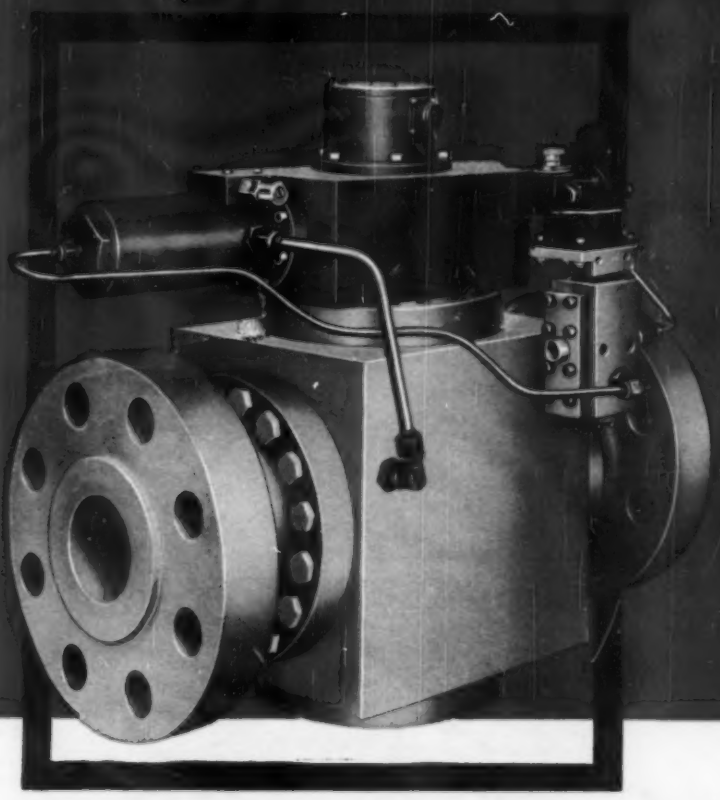


New Ceramic Tubes

Family of new miniature ceramic tubes, designed for operation at temperatures of 300C, which has been developed by General Electric were displayed for first time at recent Institute of Radio Engineers convention alongside the type 7077 (bottom photo, lower left), a UHF triode, currently in production. The Z-2537 (top left) is a UHF diode, the Z-2692 is a cold-cathode voltage reference diode, the Z-2664 is a high gain triode; the Z-2536 is a power rectifier; the Z-2696 is a lug-terminal version of the type 7077 triode; the Z-2353 is a high-mu triode for audio or radio frequency use; the Z-2354 is a power triode; the Z-2693 is a high-mu triode with a 25,000 micromhos transconductance; the Z-2352 is a medium-mu triode for AF or RF applications and the Z-2727 is a power pentode. Application of new ceramic tubes includes a miniature 1,200 mc. RF amplifier (photo at top) using the type 7077, which has a 15 db. gain and 8 db. noise figure and a five-stage intermediate-frequency amplifier, operating at 60 mc., which also uses the 7077 triode to provide 75 db. gain and a 1.2 db. second-stage noise figure.

Split-second operation at





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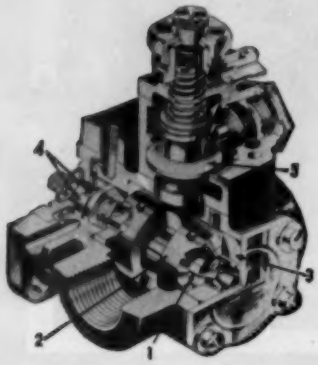

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5. Integral relief valve

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parked 15 yd. apart in a line 100 yd. away as distinct, separate objects and provided a clear picture of the boundary fence around the landing area. H. W. Upton points out that a sharp picture like this is essential to a pilot trying to land blind at a heliport or airfield.

Du Mont Scan Converter

Allen B. Du Mont Laboratories is developing a scan converter designed to present the forward radar information on the vertical display in the integrated system. The Du Mont system will present obstacle information in the flight display with the proper range information and superimposed on the basic ground plane display being used in the Army-Navy Instrument Program. Bell is testing the Bendix radar with the Plan Position Indicator display now, and work will start with the forward looking display this month when the Du Mont scan converter has been mated with the radar.

Du Mont is also developing an electronic ground plane generator which is scheduled to be available this month. Paralleling this Du Mont program, Bell has developed an electromechanical display generator in its own shop for test purposes, and both pieces of equipment will be evaluated for the job of generating the picture on the vertical display.

All of this equipment is being developed under the Army-Navy Instrument Program, a long-range research project which is supposed to come up with an uncomplicated, completely integrated flight control system which will permit all-weather operation of both fixed-wing and rotary-wing aircraft. Bell is program manager for the helicopter phase of the program, and Douglas Aircraft Co. is running the fixed-wing phase.

Bell is using two helicopters in its part of the program. The RH-1 is an HTL-7 which is used to test new hardware and which serves as a testbed for the preliminary test of the program concept. The RH-1 also has a detachable cockpit which can be attached to a dynamic simulator to compare results of real and simulated test runs. The RH-2 is a new turbine-powered HU-1 off the Bell production line, and this is the machine which will eventually be the testbed for the integrated flight control system which the Army-Navy Instrument Program effort will produce.

Work Monitored

Since some of the hardware developed may fit both programs, Bell and Douglas monitor each other's work closely. The Bendix radar, for example, can be used on fixed-wing aircraft as well as helicopters, although the limited range probably would restrict its use to small liaison, cargo and utility aircraft.

Vertol YHC-1B Chinook Flying Crane

Artist's conception of turbine-powered Vertol YHC-1B Chinook helicopter, which will be designed for U. S. Army by Vertol Aircraft Corp. Vertol was winner of a five-company competition for the two- to three-ton transport and flying crane. Choice has been under discussion for some time but primary trouble has been financial (AW Mar. 9, p. 87). YHC-1s are outgrowth of Vertol Model 107, of which 10 have been ordered by Army.

Canadair CL-28 Argus Trains With Submarine

Canadair CL-28 Argus works a training mission over the Atlantic ocean with a British Royal Navy submarine on loan to the Royal Canadian Navy. Maritime Air Command aircraft is equipped with new radome (AW Oct. 27, p. 109) that cuts CL-28's weight and drag.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command Aeronautical Systems Center:

Military Products Division, International Business Machines Corp., New York, various components of the AN/ASB-4 and AN/ASB-9 bombing navigational system, spare parts, data and drawing revisions, (PR's PE-9-1280-4246 and amendments 1 and 2, PE-8-1280-3811, EG-9-1280-4362, WR-9-1280-763 and EG-9-1280-4342), $2,334,512.

United States Steel Corp., Pittsburgh, Pa., stainless steel sandwich rolling program, (PR PB-8-MMP-6289), $410,371.

Atlas Film Corp., Oak Park, Ill., production of a 35 mm. Eastman color negative motion picture entitled "The Squadron Officer School," SFP 615, RFP 33-600-59-5021, $26,794.

Lockheed Air Service International, Inc., New York, maintenance of VC-137A type aircraft, (PR OC-9-01F-VC-137A-10431), $61,113.

Continental Aviation and Engineering Corp., Detroit, Mich., facilities for the production of J69 engines, (PR BI-9-F-9132), $29,882.

Fairchild Camera and Instrument Corp., Syosset, L. I., N. Y., 50 ea., camera bodies, still picture, aircraft reconnaissance camera, type D-3A and 102 ea., lens cones, aerial camera, type C-6A, spare parts and related data for use in RF-101 aircraft, (PR MO-9-6760-2103 and MO-9-6720-1108), $266,881.

Pioneer Central Division, Bendix Aviation Corp., Davenport, Iowa, 250 ea., transmitter, rate of flow, fuel, type J-5, Aerno 61-2453 used on T-37A aircraft, (PR EA-9-05D-4371), $51,200.

Northrop Division, Northrop Inc., Hawthorne, Calif., develop and design improved methods for consistently producing quality high strength, lighter weight aluminum and magnesium castings using permanent molds and centrifugal force techniques, (PR PB-8-MMP-6235 and amendment No. 1), $193,839.

Tele-Dynamics, Inc., Philadelphia, Pa., 109 ea., telemetric data transmitting sets, AN/AKT-7, spare major components (black boxes), maintenance spare parts, test equipment and spare parts, data for use on drone (QF-80) aircraft, (PR SM-9-16A-2019 and MD-9-16A-35118), $776,625.

Sundstrand Aviation Division, Sundstrand Machine Tool Co., 40 ea., components of 60 kva. speed drive consisting of transmission and governor assemblies, shafts, flanges, frequency and load controller and current transformers for support of B-52 aircraft, (PR EA-9-031-4375), $128,080.

Kaiser Aircraft and Electronics Corp., Phoenix, Ariz., radio set 618S-1 modifies for 88B operation, (PR EC-9-16A-4500), $73,667.

R. C. Allen Business Machines, Inc., Grand Rapids, Mich., 986 ea., indicators, turn and slip, 4 min., type MD-1A, Aerno 60-5703 (spares and supply), (PR MA-9-05C-423), $116,160.

Connecticut Telephone and Electric Corp. of Meriden, Meriden, Conn., tuning drives PD-5B/ARA-19 (655 ea.), for use on C-130B aircraft, IFB-33-600-59-59, (PR PE-9-16A-4291 and MD-9-16A-35127), $39,096.

Missile Electronics Engineering Co., Van Nuys, Calif., 742 ea., amplifiers, AM-203C/ARA-19 for use on C-130B aircraft, IFB-33-600-59-59, (PR PE-9-16A-4921 and MD-9-16A-35130), $63,182.

Red Bank Division, Bendix Aviation Corp., Eatontown, N. J., 289 ea., generators, 1,000 amp., P/N 30E16-11C for L-20A and C-45 aircraft, (PR SA-9-03C-4086 and amendment No. 1), $140,292.

Sperry Phoenix Co. Division, Sperry-Rand Corp., Deer Valley, Phoenix, Ariz., 27 various components for the MA-2 automatic flight control used in the B-52 aircraft, (PR's PE-9-05F-4163; PE-9-05F-4286; and amendment No. 1; EG-9-05F-4441; MD-9-5930-15054; PE-9-05F-4163-2), $2,439,000.

Kearfott Co., Inc., Clifton, N. J., 147 ea., indicators, directional, gyroscopic, magnetic compass, type V-7A., Aeron. 60-1522, for use with B-52G, C-133B and KC-135A aircraft, (PR LME-9-05A-4367), $35,730.

Lear, Inc., Grand Rapids, Mich., various components of MC-1 automatic flight control system, used in KC-135 aircraft, (PR's

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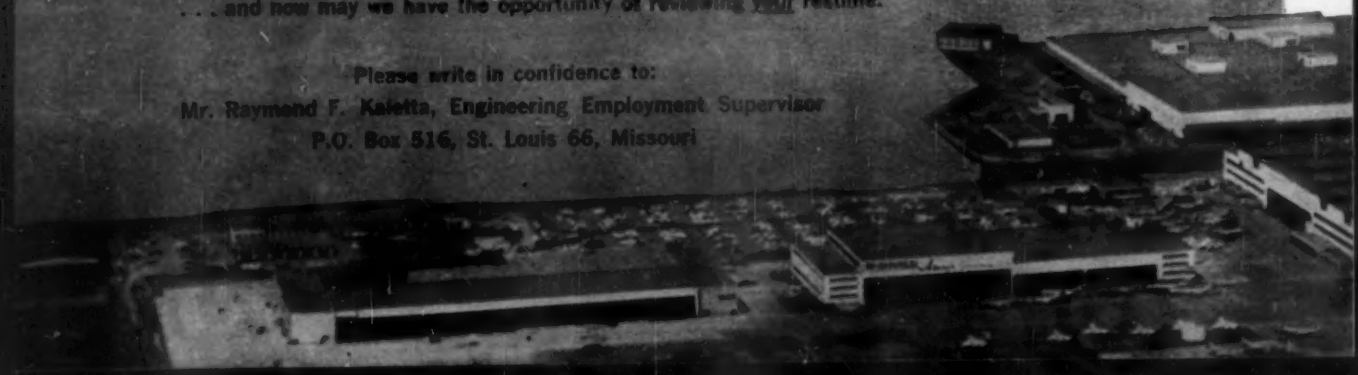

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NAME - McDonnell Aircraft
ADDRESS - Beautiful suburban St. Louis, Missouri
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HEALTH - Excellent, growing with vigor and stability.
PHYSICAL APPEARANCE - 3,930,076 gross square feet of floor area dedicated to the mastery of air and space. A beautiful campus-like environment featuring the most advanced facilities for creative achievement.
SIZE - A total staff of 25,000; 4,000 of whom comprise our Engineering Divisions.

MILITARY SERVICE:

A prime contractor of U.S. Defense Department.

BUSINESS ACHIEVEMENTS:

PAST - FD-1 Phantom - First all-jet airplane to take off and land on aircraft carrier.
F2H Banshee - Famous Korean War fighter jet.
Little Henry and XV1 Convertiplane - First ramjet helicopter. XV1 Convertiplane made first successful conversion from helicopter to airplane flight.

PRESENT - Talos - the airframe and power plant of this missile designed and developed at McDonnell.
F-101 Voodoo - Holder of three transcontinental speed records, the F-101B Interceptor now in quantity production.
F3H Demon - Missile carrying all weather Navy fighter now in production and fleet service.
F4H - Production award winner for Mach 2+ all weather Navy fighter.
Quail - Prime contractor for air-launched Air Force decoy missile.
Utility Jet - Company is vigorously engaged in the Air Force UCX competition for a multi-purpose, 4-jet trainer-transport. McDonnell entry will be capable of going anywhere in the world at cruising speeds over 550 m.p.h.
Electronics - Development and quantity production of an electronic automatic checkout system for 101B aircraft. This system will completely check out the many electrical and electronic systems and sub-systems within minutes.
Space Exploration - McDonnell just awarded contract by N.A.S.A. to develop and build FIRST MANNED SATELLITE CAPSULE.

FUTURE OBJECTIVES -

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PE-9-05F-4076; PE-9-05F-4165; EG-9-05F-4334; EG-9-05F-4442), $1,488,003.

Sundstrand Aviation Division, Sundstrand Machine Tool Co., Rockford, Ill., 6 ea., transmissions; 6 ea., gear boxes; 12 ea., shafts and 12 ea., covers for support of MAP F-100F aircraft, (PR's EA-8-031-4488 and EA-9-031-4559 and amendment No. 1), $29,784.

Electronics Division, Curtiss-Wright Corp., Carlstadt, N. J., 2 ea., B-52G flight simulators and supporting items, (PR SE-9-6930-7267), $1 million.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., various components of MA-4 automatic flight control system for RB-66 aircraft (GFAE), (PR MA-9-05F-119), $91,349.

Radio Corp. of America, Camden, N. J., 210 ea., interconnecting boxes, missile auxiliary, P/N 463004-10; 6 ea., amplifiers, electronic control, P/N 463040-100, of the MG-10 aircraft and weapons control system to fulfill MTU requirements and support MOD/IRAN program for the TF-102 aircraft, (P's WR-8-1270-474; WR-9-1270-896 and 897; WR-9-FSC-907), $87,586.

Solar Aircraft Co., San Diego, Calif., 140 ea., power and heating auxiliary unit, turbine driven, airborne, Aerno 42,2348 spare parts and ground support equipment, used on KC-135 aircraft, (PR's PE-9-02B-4301; EA-9-02B-4395; OC-9-02B-10136 and amendment No. 1), $1,771,000.

Watertown Division, The New York Air Brake Co., Watertown, N. Y., 4 ea., high speed, high pressure hydraulic pump (for service test), a(PR EA-9-RD-4373), $66,037.

Aerial Machine and Tool Corp., Long Island City, N. Y., 9,610 ea., belt, aircraft safety, lap, automatic opening, type MA-5, (PR OC-9-03F-7008), $144,632.

Sundstrand Aviation Division, Sundstrand Machine Tool Corp., Rockford, Ill., 33 ea., recirculating valve and boost pump assembly, P/N 667010 for support of project Black Knight J57P37A engine (B-57), (PR OC-9-031-6390), $93,720.

General Electric Co., Erie, Pa., 197 ea., generators, engine driven, 300 amp., 30 vdc., AN-3632-1A, in a/w specification MIL-G-6162 dated June 23, 1950, and amendment No. 1 dated Sept. 9, 1955, for H-19 aircraft, IFB-33-600-59-114, (MIPR R59-4055-TCSMC-E), $90,423.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Air Force contracting offices:

HEADQUARTERS, Ogden AMA, USAF, Hill AFB, Utah.

Ampex Corp., Palo Alto, Calif., magnetic tape, (IFB 42-600-59-151), 1,500 rolls for use on IBM magnetic tape machine, $59,175.

Electronics Division, Curtiss-Wright Corp., Carlstadt, N. J., spare parts for MB-11, MB-27A, MB-41, MB-10, S-7, S-10, MB-14 flight simulators and P-S and AP-2 trainers, (D.O. on contract AF42(600)-19274), $25,250.

Link Aviation, Inc., Binghamton, N. Y., spare parts for MB-5, MB-19 and MB-39 flight simulators and C-8, C-11 trainers, (D.O. on contract AF42(600)-19273), $86,981.

McDonnell Aircraft Corp., St. Louis, Mo., modification kits, 202 ea., engineering and technical data for retrofit of F-101B aircraft, (D.O. on contract AF42(600)-19284), $36,740.

Radioplane Division, Northrop Corp., Van Nuys, Calif., spare parts for OQ-19D radio controlled aerial target (D.O. on contract AF42(600)-19277), $82,904.

Nuclear Products-Erco Division, ACF Industries, Inc., Riverdale, Md., replacement of spare parts for type MB-26, MB-23, MB-31, MB-18 and MB-20 flight simulators (D.O. on contract AF42(600)-19275), $115,-026.

Electronics Division, Curtiss-Wright Corp., Carlstadt, N. J., modification kits, 11 ea., engineering and technical data, 7 sets, spare parts for S-9, MB-41, MB-41A and AF/F37A-T1 flight simulators, (D.O. on contract AF42(600)-19274), $354,712.

Goodyear Tire and Rubber Co., Akron, Ohio, spare parts for T-29, C-131, F-89,

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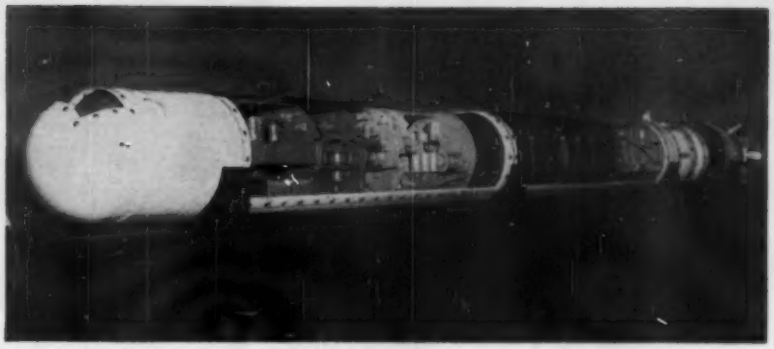


Submarine Simulators Designed for Helicopter Drop

U. S. Navy submarine simulator, torpedo-shaped device which is programed for a series of tactical maneuvers, is designed for helicopter or shipboard launching. Simulator was developed by Ordnance Division of Clevite Corp. and is used to free fleet submarines from target duty during training exercises. The device can be programed for up to six hours of tactical maneuvers and is equipped with sound simulators, radio transmitter, amplifier and other devices which duplicate noises and evasive action of an actual submarine. The simulator is 11 ft. long and 1 ft. in diameter; unit is designated X21B12. Simulator automatically surfaces and gives off smoke signal when run is complete.

C-54, C-118, B-57, KC-135 and C-123 aircraft, (D.O. on contract AF42(600)-19252), $36,614.

Barco Manufacturing Co., Barrington, Ill., spare parts applicable to B-29, B-50, and C-97 series aircraft (PR 00-9-03G-2297), $164,368.

Hydro-Aire, Inc., Burbank, Calif., spare parts applicable to F-100 aircraft, (PR 00-9-03B-2781), $1,176,152.

McDonnell Aircraft Corp., St. Louis, Mo., modification and flight testing of 19 ea. F-101B series aircraft, (D.O. on contract AF42(600)-19585), $1,366,647.

ROME AMA, USAF, Griffiss AFB, N. Y.

Bendix Computer Division, Bendix Aviation Corp., Los Angeles, Calif., Bendix G-15 general purpose digital computer and model 34-4 Flexowriter for off line preparation of program and data on punched paper tape, (IFB 30-635-59-169B), $50,708.

Gilfillan Brothers, Inc., Los Angeles, Calif., 1800-NSL modification kit in accord with ECP 617-1 for spare units to make spare units in stocks compatible with the modified radar sets, affects components of AN/FPN-16, AN/CPN-4 and AN/MPN-11, (RFP 30-635-59-6578Q), $151,072.

Marcon Manufacturing Co., Nutley, N. J., SSM-33 teletypewriter mixer in a/w specification SSM-33 teletypewriter mixer, (IFB 20-635-59-146B), $134,252.

Lewyt Manufacturing Co., Long Island, N. Y., coordinate data monitor OA-1163/FST in a/w specification MIL-M-9753 (US Air Force) (IFB 30-635-59-161B), $568,470.

Rapid Electric Co., Bronx, N. Y., FSC 6130-557-8558 power supply ECU 9/M specification MIL-P-26205, (PR MR 9-6130-26026), $244,625.

HEADQUARTERS, Air Force Office of Scientific Research, ARDC, Washington 25, D. C.

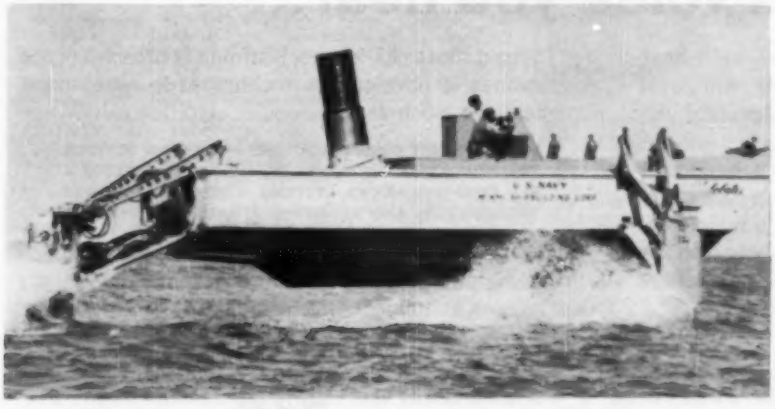
Aerochem Research Laboratories, Inc., Princeton, N. J., continuation of research on "Application of Low-Temperature Plasma Jet to Aerodynamic Studies", (AF49(638)-300), $49,276.

Fairchild Engine Division, Fairchild Engine and Aircraft Corp., Deer Park, L. I., N. Y., continuation of research on "Supersonic Combustion", (AS49(638)-15), $128,620.

Mellon Institute of Industrial Research, Pittsburgh, Pa., research on "High Resolution, Infrared Spectroscopy of Solids", (AF49(638)-542), $59,315.

New York University, New York, continuation of research on "Systems of Ordinary Differential Equations, Special Functions and Existence Theorems", (AF49(638)-229), $51,793.

General Atomic Division, General Dy-



Research Boat Utilizes Lycoming T53

New U. S. Navy research boat, the Halobates, uses hydrofoils and is powered by a Lycoming T53 gas turbine engine. Speed is in excess of 30 kt. Research boat has been undergoing exhaustive sea tests since last September.

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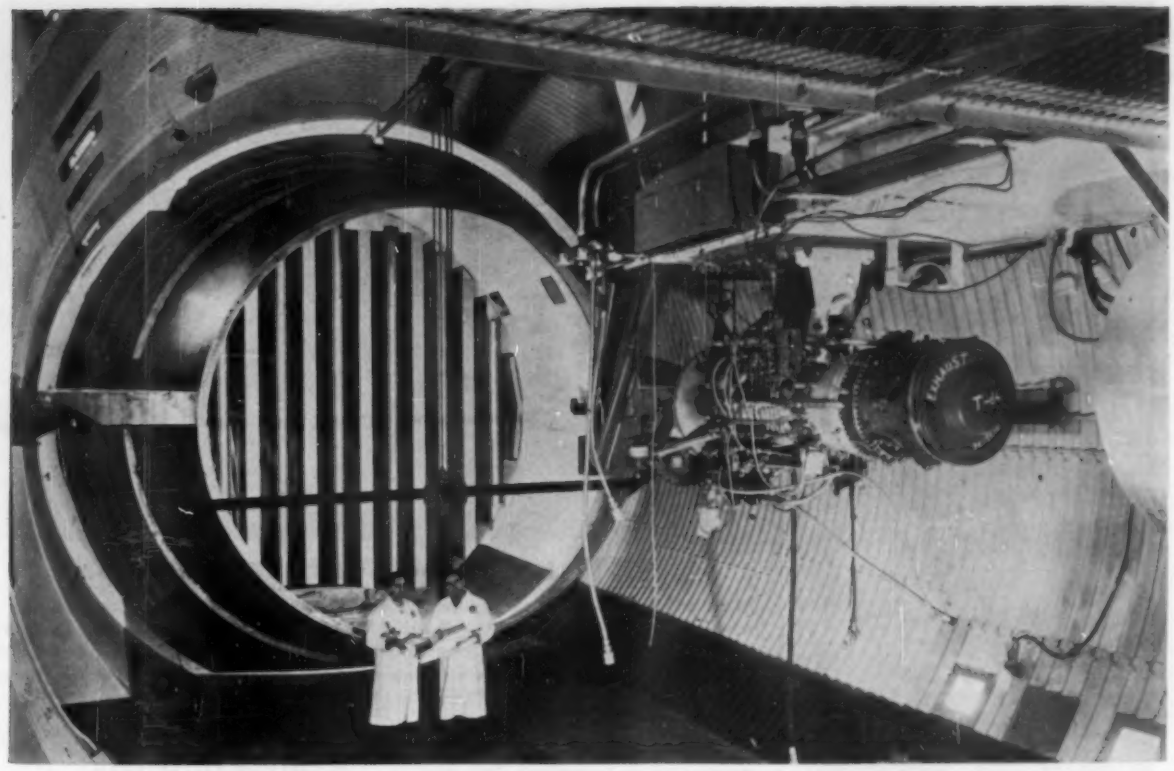

T64 Tested Under Propeller Driving Conditions

General Electric T64 free turbine engine (AW Mar. 16, p. 35) is evaluated in turboprop test cell at company's Small Aircraft Engine Department, Lynn, Mass. Test cell is framed with 24-ft.-dia. corrugated steel culvert pipe and is 120 ft. long over-all. It has 15 ft. of acoustical baffling at each end for noise suppression. Cell was built to test the T64 under actual propeller driving conditions.

namics Corp., San Diego, Calif., continuation of research on "Formation of Free Radical Solids Using Atomic Beam Techniques," (AF49(638)-301), $75,327.

Duke University, Durham, N. C., continuation of research on "Psychophysiological Mechanisms of Stress Responsivity," (AF49(638)-354), $80,098.

The Regents of the University of Minnesota, Minneapolis, Minn., continuation of research on "Functional Analysis and Stochastic Processes," (AF49(638)-30), $95,680.

The University of North Carolina, Chapel Hill, N. C., continuation of research on "Non-Parametric Statistical Interference," (AF49(638)-261), $25,000.

The Trustees of the University of Pennsylvania, Philadelphia, Pa., research on "Experimental Quantum Electrodynamic," (AF49(638)-537), $31,130.

Yale University, New Haven, Conn., research on "Atomic Beam Magnetic Resonance and Quantum Electrodynamics," (AF49(638)-545), $80,200.

Aerojet-General Corp., Azusa, Calif., research on "Kinetics of Solid Phase Reactions," (AF49(638)-573), $50,000.

Massachusetts Institute of Technology, Cambridge, Mass., continuation of research in "Mechanics for Optimization of Celestial Trajectories," (AF49)(638)-363), $78,000.

General Electric Co., Cincinnati, Ohio, continuation of "Studies in Heat Transfer from Gases to Cylinders and Nozzles," (AF49(638)-243), $65,015.

AIR FORCE MISSILE TEST CENTER, ARDC, USAF, Patrick AFB, Fla.

Hallamore Electronics Co., Anaheim, Calif., one (1) closed circuit mobile television van, (PR 59-1112 contract AF 08(606)3289), $35,738.

Cubic Corp., San Diego, Calif., increase in funds, (PR 59-1145, SA #18, contract AF 08(606)-918), $163,454.

Florida Power and Light Co., Cocoa, Fla., electrical service, Patrick AFB (DO 59-4380, contract AF 08(606)-811), $99,908.

AIR FORCE FLIGHT TEST CENTER, ARDC, USAF, Edwards AFB, Calif.

Computer Equipment Corp., Los Angeles, Calif., engineering services for space time quantizer system, $79,792.

Hollywood Film Enterprises, Inc., Hollywood, Calif., services for film developing and processing, $33,664.

Sierra Electronic Corp., Menlo Park, Calif., transmitter pulse CW, $38,660.

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Navy contracting offices:

DEPARTMENT OF THE NAVY, BUREAU OF AERONAUTICS, Washington 25, D. C.

Loral Electronics Corp., New York, 707 CP-381/ASA-13A equipment; 296 AM-1234B/ASA-13 equipment; 95 ID-499/ASA-13 equipment; 949 MT-1571/ASA-13 equipment; these equipments to be furnished in a/w specification MIL-C-18191 (Aer.), NOas 59-0224-r (PD-31-1748-59), $3,238,111.

M. Ten Bosch, Inc., Pleasantville, N. Y., one set of air-sea-rescue lights and two sets of prototype air-sea-rescue lights in a/w specification XEL-817 with exceptions of paragraph 1.2, paragraph 3.1.4 and paragraph 33.8.3, NOas 59-6086-f(AE-82-4600-59), $61,071.

Admiral Corp., Chicago, 393 KY-52B/ARW audio decoders and 402 MT-952/ARW mounts in a/w specification MIL-R-7924A (Aer.), NOas 59-8024-f(PD-32-1696-59), $335,293.

Spartan Electronics Division, Spartan Corp., Jackson, Mich., 10,000 sonobuoys, AN/SSQ-23 in a/w specification MIL-S-19763 (Aer.) and amendment No. 1 with the exception of requirements of paragraph 4.2.2, NOas 59-0214-f(PD-32-1745-59), $1,709,115.

Photogrammetry, Inc., Silver Spring, Md., two 70mm. photoblique plotters, NOas 5-6115-c(PH-40-3391-59), $29,784.

Convair Division, General Dynamics Corp., San Diego, Calif., 36 man months of field engineering services for model R47-1 aircraft, NOas 59-4039-s(MA-60-782-59), $49,380.

Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J., 11½ man months of field engineering services for R3350 series engines installed in French (MDAP) aircraft, NOas 59-8013-s(MA-60-902-59), $28,587.

Midwest Research Institute, Kansas City, Mo., develop a system to protect aircraft personnel and equipment from intense thermal radiation, NOas 59-6112-c(AE-44-4736-59), $33,131.

AVIATION SUPPLY OFFICE, 700 Robbins Avenue, Philadelphia, Pa.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., services and modification parts: to modify, repair and overhaul controllers, N383-56567A (383/216207/59), 160 ea., $92,822.

Barber-Colman Co., Rockford, Ill., actuators and control boxes: for ventilation and de-icing systems on various aircraft, N383-52781A (383/211056/59), various, $88,017.

Aeronautical and Instrument Division, Robertshaw-Fulton Controls Co., Anaheim, Calif., regulators: aviator's miniature oxygen breathing, N383-58036A (IFB-383-284-59), 965 ea., $137,513.

Pioneer-Central Division, Bendix Aviation

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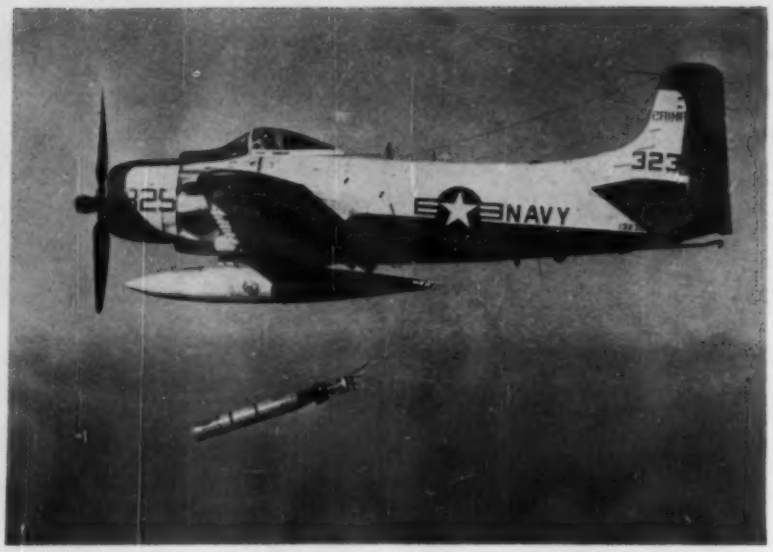


Navy Tests Mark 44 Air-Launched Torpedo

Mark 44 torpedo, a small, lightweight electrically propelled target-seeking missile, is released from a Navy Douglas AD-4B anti-submarine warfare aircraft. Small parachute will be released when wire attached to rear of torpedo is pulled taut. Upon impact with the water's surface the parachute is automatically released and the torpedo begins its run. The torpedo was designed to be launched from surface ships as well as aircraft.

Corp., Davenport, Iowa, converters: used on oxygen systems for various aircraft, N383-57678A (383/211220/59), various, $72,827.

Switlik Parachute Co., Inc., Trenton, N. J., strap assemblies: raiser and shoulder, left and right integrated parachute back, N383-58142A (IFB-383-228-59), 715 ea., $33,626.

Duracote Corp., Ravenna, Ohio, plastic sheets, floor covering, vinyl coated glass fiber with neoprene impregnated, N383-59140A (IFB-383-269-59), various, $54,959.

Stratos Division, Fairchild Engine & Aircraft Corp., Bay Shore, L. I., N. Y., services and material: to overhaul, repair and restore to operating condition, turbine drive assemblies, N383-57909A (383/212069/59), various, $289,418.

Dalmo Victor Co., Division, Textron, Inc., Belmont, Calif., actuator assemblies: for use on airborne radar equipment, N383-57541A (383/233280/59), 59 ea., $50,283.

Aeronautical Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., indicators: fuel quantity for F9F-8T aircraft, N383-58152A 383/216441/59), 174 ea., $58,-551.

Stromberg Time Corp., subsidiary of General Time Corp., Thomaston, Conn., time stamps: electric, motor driven, magnetic imprint, N383-(MIS)-58129A (IFB-383-472-59), 312 ea., $27,241.

Sundstrand Aviation Division, Sundstrand Machine Tool Co., Rockford, Ill., gear assemblies: used on switch assembly for P5M-1 and -2 aircraft, N383-57405A (383/212132/59), various, $43,344.

The Eagle-Picher Co., Cincinnati, Ohio, batteries: water activated, N383-58338A (IFB-383-469-59), 13,416 ea., $30,857.

Colvin Laboratories, Inc., East Orange, N. J., potentiometers: absolute pressure instruments, N383-58421A (IFB-383-440-59), 240 ea., $30,360.

The Hart Manufacturing Co., Hartford, Conn., relays: electronic, for use on FJ-3 aircraft, N383-57988A (383/234572/59), various, $45,584.

Master Specialties Co., Los Angeles, actuator assemblies: parachute barometer time, delay, N383-57846A (383/271137/59), various, $46,799.

The American Pad & Textile Co., Greenfield, Ohio, lifeboats: personnel, balsa wood body, N383 (155-MIS)-58316A (IFB-383-491-59), various, $40,575.

Army Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Army contracting offices:

U. S. ARMY ENGINEER DISTRICT, Jacksonville, Corps of Engineers, 575 Riverside Ave., Jacksonville, Fla.

Rader & Associates, Miami, Fla., design of Minuteman launch facilities, Cape Canaveral Missile Test Center, Patrick AFB, Fla., $72,500.

Alexis B. Kononoff, Miami, Fla., design of Minuteman (WS-133A) facilities, AFMTC, Patrick AFB, Fla., $87,000.

DISTRICT ENGINEER, U. S. ARMY ENGINEER DISTRICT, Little Rock, P. O. Box 867, Little Rock, Ark.

Ben M. Hogan & Co., Little Rock, Ark., apron, operation, alert, Little Rock AFB, Ark., (IFB ENG-03-050-59-30B), $1,313,-077.

T. L. James & Co., Inc., Ruston, La., apron, operation, alert, Barksdale AFB, Shreveport La., (IFB ENG-03-050-59-32B), $1,155,799.

U. S. ARMY ENGINEER DISTRICT, Detroit, Corps of Engineers, 1101 Washington Blvd., Detroit 31, Mich.

Smith & Andrews Construction Co., Oak Park, Mich., construction of composite structures, including all related work necessary and appurtenant thereto, at Selfridge AFB, Mt. Clemens, Mich., (IFB ENG-20-064-59-40), $1,113,681.

Omega Construction Co., Grand Rapids, Mich., construction of blast deflector fences, including all related work necessary and appurtenant thereto, at Wurtsmith AFB, Marquette Co., Mich., (Invitation No. ENG-20-064-59-47), (schedule No. 3), $124,920.

High Voltage Systems, Inc., Toledo, Ohio, alterations to base electrical substation, including all related work necessary and appurtenant thereto, at K. I. Sawyer AFB, Marquette Co., Mich., (Invitation No. ENG-20-064-59-48), $44,646.

Electric Construction and Machinery Co. of Michigan, Inc., Detroit, Mich., construction of electrical distribution, including all related work necessary and appurtenant thereto, at Selfridge AFB, Mt. Clemens, Mich., (Invitation No. ENG-20-064-59-49), $102,299.

British Accident Report:

Pilot Misread Altimeter in Viscount Crash

(Following is a report to the British Minister of Transport and Civil Aviation by P. G. Tweedie, chief inspector of accidents, into the circumstances of the crash of British European Airways Corp. Viscount 802 G-AORC April 28, 1958, at Tarbolton, Ayrshire, Scotland. Five crew members were injured; the aircraft carried no passengers.)

The accident occurred during an unscheduled flight from London to Prestwick where the aircraft was to pick up passengers for BOAC under a charter arrangement and fly them to London.

The aircraft had taken off at 2042 hr.[1] from London Airport, had cruised on the airways at 18,500 ft. and had commenced the descent to Prestwick with an initial clearance to 8,500 ft. Within a few minutes the clearance was amended to cross the Prestwick radio beacon at 4,000 ft. The descent appeared to the pilots to be normal until the aircraft struck the ground close to the site of the beacon very shortly after the captain had reported passing 11,000 ft. in the holding pattern.

The aircraft slid along the ground for 400 yd. and fire broke out in the starboard wing. The three cabin crew escaped without difficulty but the cockpit door was jammed. The captain managed to force himself through the port sliding window in the cockpit but the first officer was unable to do so. The captain re-entered the aircraft through the front door and assisted the first officer to force his way through the cockpit door.

The fire spread slowly and consumed almost the entire aircraft. The fire services reached the scene some 50 min. later.

The Aircraft

The aircraft was constructed by Vickers-Armstrongs (Aircraft) Ltd. at Weybridge in 1957 and was registered in the name of British European Airways Corp. It had flown for a total of 1,311 hr. The Certificate of Airworthiness was issued on Aug. 9, 1957, and was valid. The airframe and engines had been maintained in accordance with an approved maintenance schedule and there was a valid Certificate of Maintenance. The loading was within the permissible limits.

The Crew

Capt. W. H. Hankin, aged 42, held a valid Air Line Transport Pilot's license with an Instrument Rating and an endorsement in Group 1 for Viscount aircraft. At the time of the accident he had completed 10,135 hr. flying, of which over 9,000 were in command and 766 were on the Viscount Type 802. (He was seriously injured.)

He joined BEA in December, 1945, and was promoted captain on Oct. 24, 1946, and flew successively Dakota, Viking and Ambassador type aircraft. His records over the last five years with the corporation show his instrument flying to have been consistently sound and his airmanship, drills and procedures all to have been to a high standard.

At the same time there occurred comments that his reaction is somewhat slower than in the majority of airline captains and that he has a tendency to try to do too much. Again from the records it seems that Capt. Hankin had some difficulty in coordinating his duties when on conversion training to the Viscount 802, which has been operated by a crew of two pilots since its introduction, and he had to be given an extension of the normal training period in consequence.

When promoted to Senior Captain (Second Class) in November, 1951, he was assessed as a capable commander of aircraft who had always carried out his duties in a keen and efficient manner.

First Officer B. Fleming, aged 39 (who also was seriously injured) held a valid Air Line Transport Pilot's license with an Instrument Rating and an endorsement in Group 1 for Viscount aircraft. At the time of the accident he had flown a total of 5,260 hr. of which 544 were on the Viscount Type 802.

After serving in the Royal Air Force, he was demobilized in 1947 and returned to his civilian occupation of clerk. He joined BEA on Sept. 26, 1951, as a Second Officer (Trainee), obtaining a commercial license on his own initiative. He obtained an Air Line Transport Pilot's license on Jan. 16, 1958. After initial training, he flew Dakota aircraft from Northolt and Renfrew before being posted to Gibraltar on Jan. 1, 1954, also on Dakotas. After three years there, he returned to this country for conversion to the Viscount 802.

His records with the corporation show that his duties as a First Officer were usually carried out competently and conscientiously, but there are entries which draw attention to a certain slowness and lack of self-confidence. At the end of his Viscount 802 conversion course, with which he had had some difficulty, it was said that in view of the amount of time and work taken to achieve an acceptable standard, he would require regular practice to maintain that standard.

(Other members of the crew were Steward M. Klancewicz, slightly injured; Stewardess, A. M. Hanel, slightly injured, and Stewardess R. Wedderburn-Maxwell, seriously injured.)

Meteorological Data

The weather at Prestwick at 2150 hr. was given by the local meteorolgical office, and passed to the aircraft, as:

Surface Wind.....230 deg., 9 kt.
Visibility.....3 naut. mi.
Present Weather.....Mist
Cloud.....$\frac{1}{8}$th cover at 200 ft. $\frac{3}{8}$ths cover at 300 ft. and $\frac{7}{8}$ths cover at 800 ft.

[1] All times mentioned are Greenwich Mean Time.

CJ805-3 Turbojets Tested in Cold Weather

General Electric CJ805-3 turbojet engines mounted in a USAF Douglas RB-66A testbed are subjected to cold-weather environmental testing at Duluth, Minn. Turbojets, rated at approximately 15,000 lb. thrust each, power Convair 880 transport (AW Mar. 2, p. 60).

A special cloud base report at 2210 hr. gave ⅛th cover at 200 ft., ⅜ths cover at 400 ft. and ⅜ths cover at 2,500 ft.

On the day of the accident, Capt. Hankin was rostered for "Available 2" duty which involved being on call at home from 1400 hr. to 2200 hr. He spent the morning and afternoon working in his garden, and at about 1730 hr. received a telephone call from the BEA Roster Room at London Airport asking him to take a charter flight to Prestwick departing at 2030 hr. He left home by car and reported to the Flying Staff Duty Officer at London Airport at 1920 hr. There he was joined by First Officer Fleming whom he had not met before.

First Officer Fleming was rostered for "Standby 3" duty which involved being available at London Airport from 1600 until 2100 hr. He had had a rest of about an hour and a half in bed before leaving home for London Airport where he had reported at 1600 hr.

Capt. Hankin went to the Meteorological Office to be briefed and to collect his Flight Forecast form, then he and the first officer obtained a thorough briefing on Prestwick in the Aeronautical Information Service briefing room. They went out together to the aircraft, carried out the checks and drills, taxied out and took off at 2042 hr. The two pilots provided the operational crew and the captain was in the lefthand seat at the controls throughout the flight.

The aircraft climbed to, and maintained, 18,500 ft. on airways and the captain had calculated that he would start the descent at 2154 hr., i.e. five minutes before his ETA at New Galloway radio beacon. He passed this information to Scottish Airways at 2147 hr., adding that he understood the Prestwick weather was not too good and that if it was below his minima, he proposed diverting to Renfrew.

He was given the Renfrew weather in reply as 5 naut. mi. visibility, with ½ cover of cloud at 800 ft. and ⅜ths cover at 1,800 ft.

Approach Procedure

Descent was actually begun at 2153 hr. with initial clearance to 8,000 ft., and at 2154 the 2150 Prestwick weather was passed to the aircraft. This put the cloud base just below the BEA minimum of 400 ft. The captain then said that he would carry out an approach using ILS to Runway 21 down to the minimum. He reported passing New Galloway at 2157 hr. at 13,000 ft. descending to the recleared altitude of 4,000 ft. and estimating Prestwick Beacon (GJR) at 2204. A change of R/T frequency was then made to Prestwick Approach and in his initial call just after 2158 hr. the captain said that he was at 11,000 ft., descending to 4,000, and again gave his intentions.

Between 2203 and 2204 hr. the captain told Prestwick Director (GCA), who was going to position the aircraft for the ILS, that he was then at 14,500 ft. descending. The Director Controller replied by saying "You are too high for me at the moment. I'll take you from the holding pattern when you reach the beacon." At 2205 hr. the captain reported over the beacon at 12,500 ft. and began a holding pattern in order to lose altitude.

At 2207 hr. the captain passed his altitude as "Just left eleven descending" and this was the last message received from the aircraft. It crashed at about 2208 hr. close to the radio masts at the position of the Prestwick Beacon, a little less than three miles northeast of the threshold of Runway 21.

In a statement made in hospital 11 days after the accident, Capt. Hankin said:

"The clearance to descend came through just before 2153 and I throttled back to begin a standard descent from 18,500 ft. At 2154, Scottish Airways passed me the 2150 Prestwick weather, which put the cloud base below the critical height shown in the Operations Manual. On hearing this, I gave Airways my intentions. Initial clearance had been to 8,500 ft. and this was changed at 2156 to 4,000 ft. or above at the Prestwick Beacon. I called passing New Galloway at 2157, gave an ETA for GJR of 2204 and gave my altitude as 13,000 ft. I do not remember this now, but believe that the altitude given must have been accurate. I was cleared then to Prestwick Approach.

"Before calling Prestwick Approach, I gave Fleming instructions for the overshoot should we have to do one. Before leaving London Airport I had told him that we would not do a monitored approach at Prestwick. I then called the Approach, giving them my intentions, ETA at GJR, and my height as 11,000 ft. descending to 4,000 ft. They repeated the 2150 weather and gave me the airfield QFE and QNH, but because I had already had the weather, I only noted the QFE, because it is my own practice to compare QFE on my altimeter with the Zone QNH (not the airfield QNH) on the other. There were then further exchanges between us on the R/T at the end of which (2201½ approx.) there was a short period of silence.

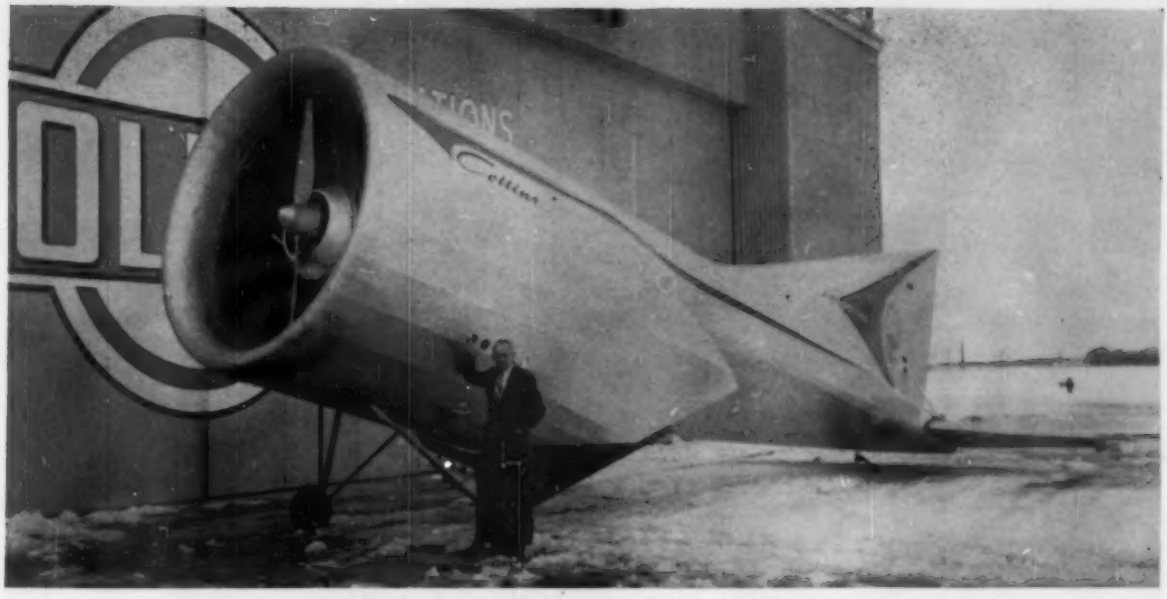
Altimeter Check

"I believe that it was during this period that I asked Fleming to get on with the initial checks, and towards the end of the period that I thought of checking one altimeter against the other. I think I said to Fleming, 'We may as well check the altimeters now,' or words to that effect. As I did so, I set the QFE on mine and added to Fleming, 'What's your reading?'. I distinctly remember answering his reply by 'No, not that—what is the difference? It should be about 80 ft.' I was then looking on the let-down sheet for the airfield elevation when Prestwick Director transmitted to me just after 2203 and interrupted me. When I passed my altitude as 'fourteen point five,' I believe that I gave it, certainly not by looking at my own altimeter (because it was on QFE), but rather as a result of my exchanges with the first officer a few seconds earlier, together with a glance across at his altimeter, which was still on Zone QNH, and which I remember reading as 14,300 ft.

"I believe that Fleming replied to my initial question by giving the altitude shown

Bell Producing HU-1A, H-13H Helicopters

Bell HU-1A Iroquois and Bell H-13H Sioux helicopters are in production at Bell Helicopter Corp. Hurst plant, between Ft. Worth and Dallas, Tex. Company has received production contracts from U. S. Army totaling $23 million (AW Mar. 16, p. 35), extending production into 1961. Iroquois (at left) is powered by a Lycoming T53 free turbine engine derated to 770 shp. at 6,400 rpm. H-13H is (line at right) equipped with a Lycoming VO435 engine, producing 200 hp. and can carry three persons.



Aerodyne VTOL Mockup Rolled Out

Full-size mockup of the Aerodyne VTOL designed by Dr. A. M. Lippisch (in photo) of Collins Radio Co. is rolled out at the company's Aeronautics Research Laboratories, Cedar Rapids, Iowa. Aircraft is being developed jointly by Army Transportation Corps and Office of Naval Research and will be delivered to National Aeronautics and Space Administration's Ames Laboratory, Moffett Field, Calif., for full-scale wind tunnel tests. Aerodyne channels airflow from two contrarotating propellers through the fuselage and deflects it through controllable belly vents (AW April 14, 1958, p. 31). Cockpit will be located aft under a canopy in the vertical stabilizer.

on his altimeter, and I think he probably said '14,500.' I know that as soon as I had got out of the aircraft a few minutes later, I knew what had caused the accident and I put the source of the error at this moment. Prestwick Director's reply of 'You are too high for me at the moment' could have done nothing but confirm the error in my mind, even though I know now that the radar operator was basing his remark only on what I had just told him. As I was looking at the let-down sheet on my knee to check the 80 ft., the red ADF needle (on GJR) started to go round, and I disengaged the autopilot, set the required heading on the Smiths System, put the aircraft into a left turn, and turned the S.F.S. selector to "Radio Off" to disconnect the ILS from the system. I called the Approach in the turn, giving an altitude of 12,500 ft., which I can only have read from my own altimeter. As soon as I had reached the heading of 075 deg., I selected 43% of flap with the intention of increasing the rate of descent. After a one-minute leg I turned back to regain the beacon. During this turn I must have sent my last height of 11,000 ft. and just after completing the turn, we must have struck the ground, although I do not remember the impact."

First Officer's Statement

In a statement made, also in hospital at the same time, First Officer Fleming said:

"Some time before reaching Dean Cross Capt. Hankin told me that he would commence descent a few minutes before New Galloway. On checking Dean Cross I remember that he gave an ETA New Galloway with a request to descend three or four minutes before this ETA, and I also remember that these two times coincided with my own calculations. We were given descent clearance from 18,500 ft., where we had been cruising, down to 8,500 at or just before our requested descent time. As soon as we received this clearance Capt. Hankin throttled back and we began the descent.

"I remember copying down the Prestwick weather at about this time, and I also remember Capt. Hankin telling me that we would not be doing a monitored approach to Prestwick. I do not remember hearing the reclearance to 4,000 ft. over the GJR Beacon which was passed to us at 2156. I remember changing frequency after Capt. Hankin reported over New Galloway, but do not remember the altitude given. As soon as I had done this, I began to tune the No. 2 ADF, which had been on New Galloway, to the Prestwick ILS Locator Beacon (PN). The No. 1 set I had already tuned, before passing Dean Cross, to the Prestwick Beacon (GJR).

"The Decca Flight Log had been working accurately throughout the flight and was still doing so. I had had to do a chart change around New Galloway.

"I could only hear PN faintly and told Capt. Hankin that I had got it roughly. The needle was not giving a steady indication, but GJR was showing steadily on the other needle. I must have been engaged in this tuning at 2159 when Prestwick Approach passed us their 2150 weather and the airfield QFE and QNH, and I remember Capt. Hankin asking me at about that time to set the QNH on my altimeter and to check the difference between the two against airfield altitude. I think he said the difference should be about 80 ft. I remember setting my altimeter, then looking at Capt. Hankin's. I only looked at the hundred-foot pointers in each case and noted the difference was about 80 ft.

"Because I was engaged in tuning the ADF at the time I did not hear Capt. Hankin pass our height as 11,000 ft. when he first called the Approach. During this time I had been conscious that the descent was being made quite normally.

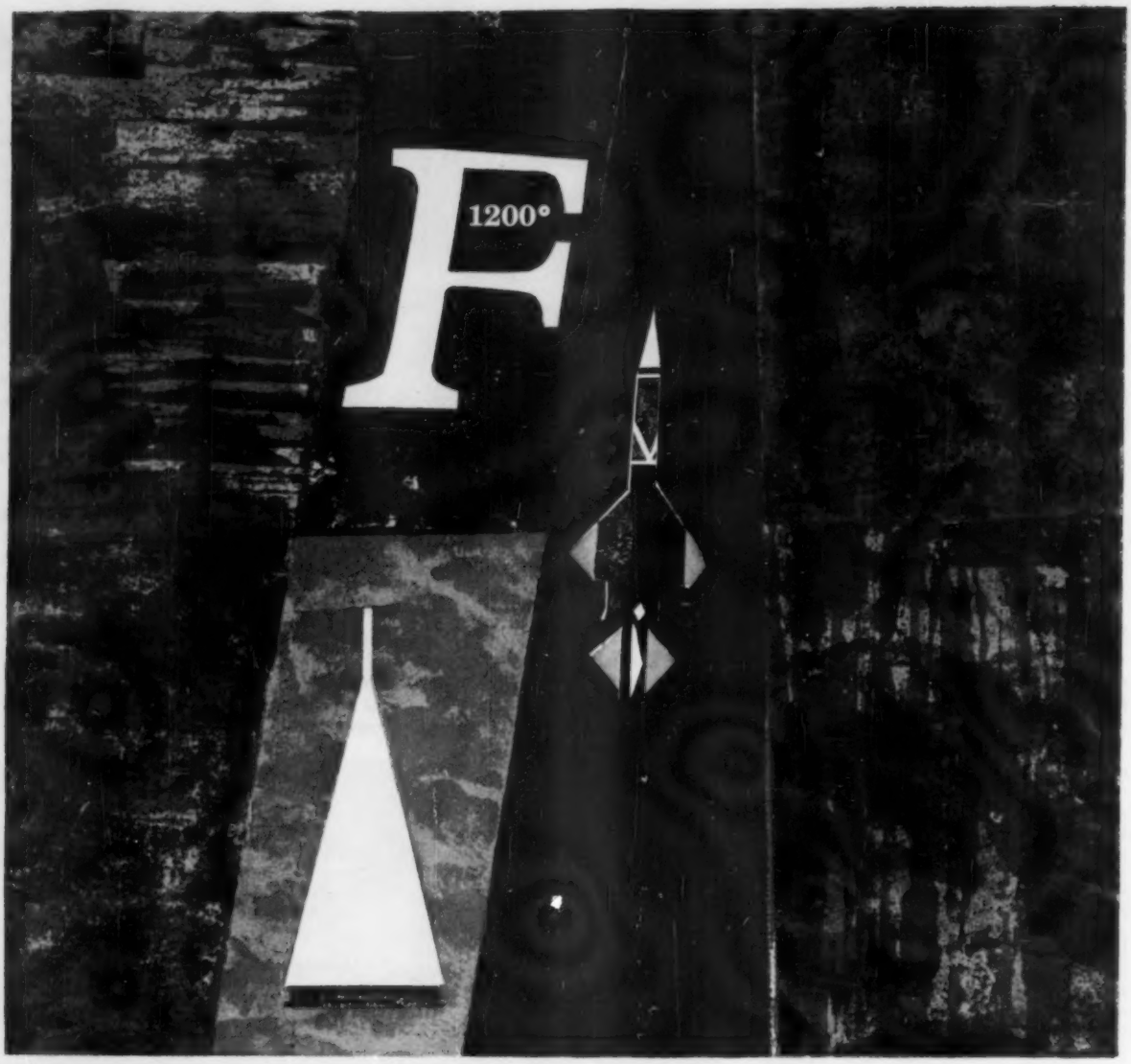
'Carry Out Drills'

"Somewhere about this time, Capt. Hankin, in view of the possibility of having to overshoot because of the weather, told me what he wanted me to do, which was to carry out the drills. I definitely do not remember hearing Capt. Hankin give our altitude as 14,500 ft. between 2203 and 2204, neither do I remember any of the conversation shown on the transcription at this time between the Director and ourselves. I think this can be explained by the fact that I was then trying to confirm the tuning of the PN Beacon.

"Just before we reached GJR Beacon, I saw a few scattered lights on the ground, and remarked to Capt. Hankin that the cloud could not be as bad as they said it was. Also immediately I felt the aircraft bank to the left and realized from the Decca that we were over the beacon.

"I then got busy realigning the Decca for greater accuracy. Again I do not remember Capt. Hankin's R/T conversations at 2205 and 2207 when he gave his heights as twelve point five and 11,000 ft. respectively. I think that throughout the descent I was concentrating on the radio navigation aids, and I was never conscious of being at any precise altitude, but only of descending."

Inspection at the scene of the accident showed that the aircraft had struck gently



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rising pasture in a slightly nose-down attitude, but with the wings laterally level, on a southwesterly heading. Although from initial impact marks the rate of descent seemed to have been high, the complete aircraft bounced back into the air, contacting the ground about 145 yd. farther on before crossing a ditch. It then ran up more steeply rising ground, hit a pole carrying high-tension cables, which were severed by the top of the fin, and finally came to rest after running a little over 400 yd. in a straight line from the point of initial impact.

One engine and two propellers had been shed on the way but otherwise the aircraft was substantially intact before being almost completely burnt out. All the indications were that the four engines were operating under power when impact occurred and no evidence was found of structural or mechanical failure.

Altimeters Removed

The two altimeters were removed and taken to the manufacturers where no pre-crash defect could be found in either instrument. The captain's was set to the QFE and the first officer's to the QNH, as passed to the aircraft by Prestwick Approach.

In the examination of the cockpit, the pressurization spill valve selector switches for Nos. 2 and 3 engines were set for the valve closed position, and for No. 4 engine for the valve open. The position of the valves was in conformity with this.

The following is an extract from BEA Flying Staff Instruction No. 107/56:—

"To achieve maximum efficiency of VHF and HF R/T communication the following should be observed:

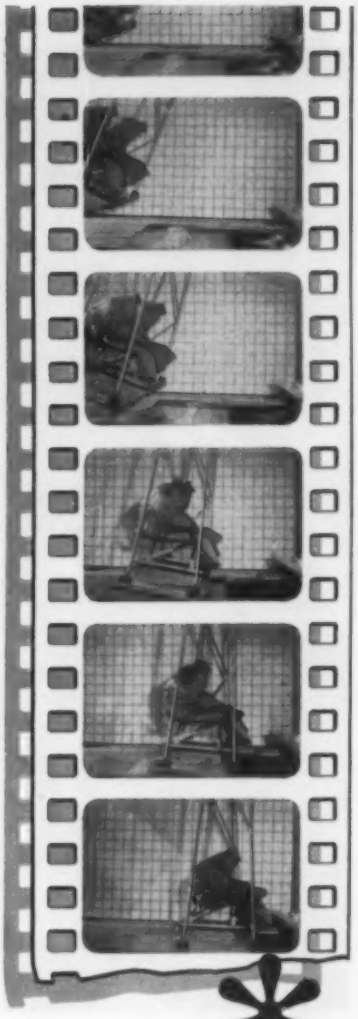
The captain should himself operate the R/T with the first officer monitoring the communications. The captain may of course at his discretion reverse this procedure."

A BEA Flying Staff Instruction lays down the following (altimeter setting) procedure:

"At the appropriate stage in the let-down procedure the captain will set the QFE given on his instrument and the first officer will set the airfield QNH on the starboard instrument. To ensure correct setting the difference in the readings should be checked as corresponding to the airfield elevation. At 1,500 ft. above airdrome level the first officer will reset the starboard instrument to QFE and cross-checks the readings on both instruments."

The BEA Monitored Approach System was adopted as a "standard procedure" in BEA as from Nov. 15, 1956, "in the interests of safety and efficiency." It was felt that the problem of errors in the control cabin which were due to a lack of effective checking and cross-checking of all vital actions, together with an unsuitable distribution of duties between the two pilots, could best be solved by the Monitored Approach System, using the first officer to fly on instruments from the start of the descent until the captain was ready to take over and land. In this system, the first officer would be free to concentrate on flying the aircraft accurately, while the captain monitored and directed his flying, communicated with ATC and was free to control every situation as it arose. By such means that workload would be more evenly distributed between the two pilots, who must in consequence be more efficient individually and as a team, and the strain and fatigue on the captain would be reduced.

It was recognized that the system demanded a high degree of confidence from the captain in the skill and capability of his first officer, together with a high degree of understanding and cooperation between



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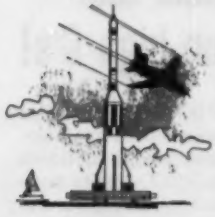

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captain and copilot to avoid possible mistakes and also that rigid adherence to correct procedures would be of paramount importance. Having a standard procedure was stressed as being particularly valuable in helping the captain and first officer to work as a team even though they may not have previously flown together.

Calculations based on time and rate of descent confirm that when the captain read the altimeter between 2203 and 2204 hr., the aircraft was at 4,500 ft., not at 14,500 as he reported. He therefore failed to notice the position of the 10,000-ft. pointer as he looked across at the first officer's altimeter. He subsequently perpetuated this initial error when reading his own altimeter at 2,500 and at 1,000 ft. when he gave his altitude as 12,500 and 11,000 ft. respectively.

The captain had calculated the time for commencement of descent on the basis of a rate of 1,500 ft. per min. and with the deliberate intention of not being too high on arrival at GJR Beacon. He began the descent at the time planned and the descent was made as intended without interruption. Despite these facts, he accepted his height without any misgiving as 1,500 ft. when he reached GJR.

Clearer Distinction

The presentation afforded by pressure altimeters having three pointers is not always conducive to rapid and accurate reading especially in regard to the 10,000-ft. pointer which can be overlooked or obscured, particularly at night. The possibility of ambiguous presentation with consequent wrong reading has been well known and there is constant endeavor to produce something better. Indeed the altimeter fitted in the Viscount 802 was taken to be a marked improvement on that fitted in the Type 701 in that it made a much clearer distinction between the three pointers.

Although he was not manually flying the aircraft because the autopilot was engaged, Capt. Hankin was controlling the descent and monitoring his instruments. On top of this he was doing all the R/T (the exchanges on which occupied about 4½ min. of the 12 min. between the start of the descent and Prestwick Beacon), writing down the weather reports, studying the approach and overshoot procedures, briefing the first officer on a possible overshoot, attending to descent and initial approach drills and checking the altimeters.

There seems little doubt that in so doing he overloaded himself to an extent that made possible the mental loss of the descent sequence.

The BEA Monitored Approach System was not being used, although the instructions issued to flying staff suggest that it should have been. In his statement the captain said that he did not use it because he had never met First Officer Fleming before and because First Officer Fleming said he had not been to Prestwick since the war. He also gave it as his opinion that use of the system would most probably have increased his workload because he would have had the additional duties of reading check lists and tuning beacons.

Although the captain was within his rights in making this decision, nevertheless it would appear probable that had he used the Monitored Approach System and followed the standard drills and procedures, or had he substituted some other procedure which made full use of his first officer, the altimeter reading error, if made at all, might then have been quickly noticed. In a two-pilot crew it is essential that the two pilots work as a team, that each knows what the other is doing and that each cross-checks the other so far as is possible.

The BEA Operations Manual requires the first officer to carry out all aircraft drills and to repeat each item verbally to the captain as it is completed. Had this been done on this occasion it is difficult to see how the confusion over the altimeter checking mentioned in the captain's statement would have occurred. Furthermore, the airfield elevation for which the captain says he was looking on the Prestwick let-down sheet had just been given to him on R/T as 64 ft., together with the QFE and QNH settings.

The fourth item for the descent checks on the BEA Viscount 802 Drill Card reads, "Spill Valves: OPEN as necessary—one at 15,000 ft. second at 8,000 ft." The pressurization spill valve operating switches are normally moved by the copilot. As the first officer had apparently opened the first, he must have realized that he had passed 15,000 ft. It is difficult to reconcile this with his recollection that he "was never conscious of being at any precise altitude, but only of descending."

During the descent from New Galloway the first officer seems to have spent too

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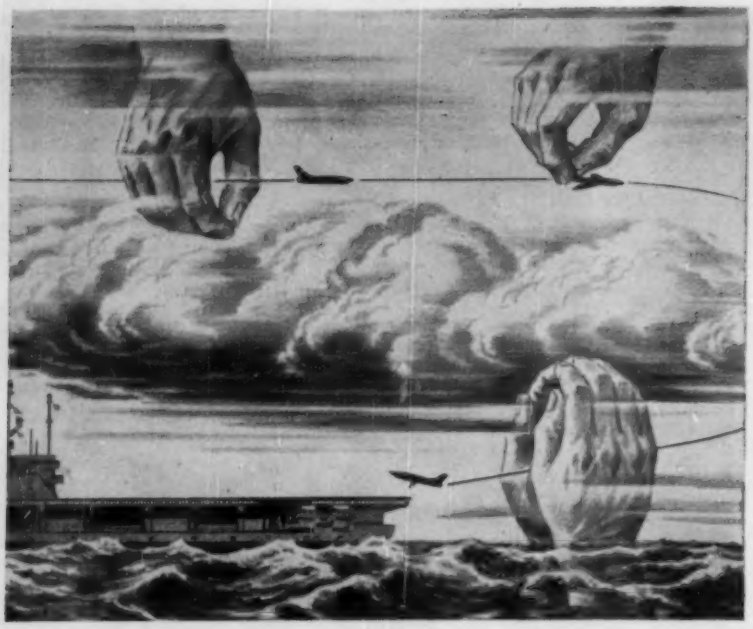

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much of the available time trying to tune the PN Beacon. As the main Prestwick Beacon (GJR) had already been tuned satisfactorily on the other ADF set; as GCA was available to monitor their ILS approach; as the Decca Flight Log was working satisfactorily, and as the PN Beacon was only a short-range locator, this continued effort was unnecessary and was undoubtedly detrimental to his vital duties of monitoring the instruments and the R/T conversations.

The first height reported by the aircraft to the Prestwick Approach Controller was 11,000 ft. Because of the normal change of frequency he had not heard the previous call passing 13,000 ft., neither did he know at what time the descent had commenced. When therefore the aircraft, some five minutes later, reported itself at 14,500 ft., he at once noticed the discrepancy.

Although there was no conflicting traffic, he spoke to the GCA Controller, who was working the aircraft at the time, and asked him to request its altitude. Before the GCA Controller could do so, however, the aircraft reported itself over the GJR Beacon at 12,500 ft. This was received about 90 sec. after the 14,500 ft. report and effectively dispelled from the Controller's mind any momentary doubts as to the aircraft's altitude.

1. The documentation of the aircraft was in order.

2. The crew was properly licensed.

3. There was no evidence of any pre-crash defect in the aircraft or its equipment.

4. The captain misread the altitude at 4,500 ft. as 14,500 ft. and perpetuated the error of 10,000 ft. until the aircraft struck the ground some five minutes later.

5. There was a lack of cooperation between the two pilots and a lack of alertness on the part of the copilot.

6. No blame for the accident can be attributed to the Prestwick Approach or Director Controllers.

The accident was caused by the captain flying the aircraft into the ground during the descent to Prestwick after misreading the altimeter by 10,000 ft. While a somewhat ambiguous presentation of height on the pressure altimeter may have initiated this misreading, a lack of cooperation between the captain and first officer and a lack of alertness on the part of the first officer were the main contributory factors.

In conducting this investigation the provisions of paragraph (5) of Regulation 7 of the Civil Aviation (Investigation of Accidents) Regulations, 1951—Statutory Instrument No. 1653 of 1951—have been complied with.

P. G. TWEEDIE
Chief Inspector of Accidents

Crash Injury Group Joins Flight Safety Foundation

Aviation Crash Injury Research (AVCIR) of Cornell University is now affiliated with Flight Safety Foundation. Project, directed by A. Howard Hasbrook, will remain at Phoenix, Ariz. Project administration will be handled by Merwyn A. Kraft, FSA coordinator of research.

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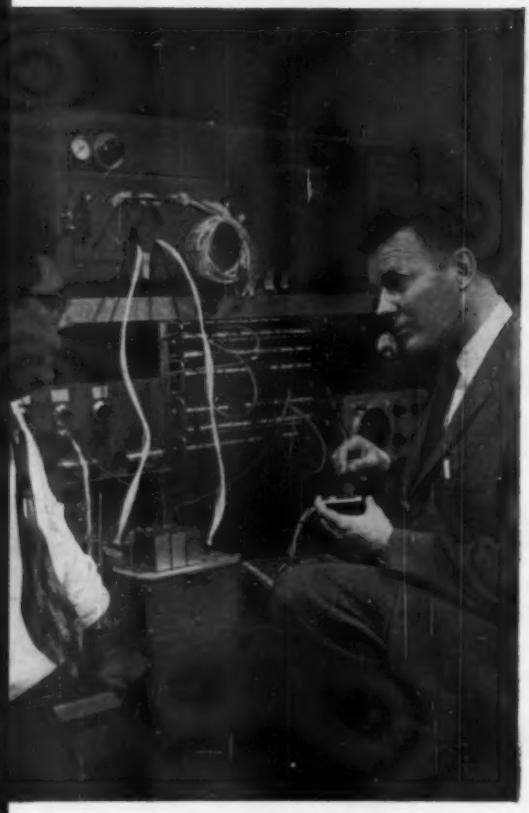

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WHO'S WHERE

(Continued from page 23)

Changes

Robert W. Bratt, chief, and **Dr. James S. Murphy**, assistant chief, Douglas Aircraft Co. Aerophysics Laboratory, El Segundo, Calif.

Russell D. Archibald, project engineer-environmental controls, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn.

Harlan C. Pringle, general contracts manager, Contracts & Service Division, Simmonds Aerocessories, Inc., Tarrytown, N. Y.

D. Brainerd Holmes, manager of the Ballistic Missile Early Warning System, Missile and Surface Radar Division, Radio Corporation of America, Moorestown, N. J.

Brig. Gen. Joseph A. Bulger (USAF, ret.), director of plans and systems, Countermeasures Division, Sperry Gyroscope Co. Division of Sperry Rand Corp., Great Neck, N. Y.

Lt. Col. James L. Farmer (USA, ret.), Army Program Coordinator, Motorola Military Electronics Division, Phoenix, Ariz.

Stephen J. Jatras, executive assistant to the vice president and acting director of marketing, Lockheed Electronics and Avionics Division, Maywood, Calif. Also: **Howard S. Hagen**, director of industrial relations.

Leonard H. Seeman, manager of the newly established Products Division, Greer Hydraulics, Inc., Jamaica, N. Y. Also: **Alphonse Jacobellis**, assistant chief engineer, Products Division.

Nicholas C. Christofilos, a consultant on the application of nuclear energy in power plants to Boeing Airplane Co., Seattle, Wash. Mr. Christofilos is a member of the University of California's Lawrence radiation laboratory.

Dr. Don R. Scheuch, assistant division director, Engineering Research Division, Stanford Research Institute, Menlo Park, Calif. **Henry P. Blanchard** succeeds Dr. Scheuch as manager of the weapons systems laboratory.

Wayne W. Wilson, factory manager, Western Division, Aeroquip Corp., Burbank, Calif.

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H. V. Perryman, corporate director of industrial relations, Lear, Inc., Santa Monica, Calif.

John H. Titley, sales manager, Defense and Technical Products Division, Rheem Manufacturing Co., Downey, Calif. Also: **John W. Atha**, supervisor, prime contract sales; **Richard L. Leesome**, supervisor, subcontract sales; **John R. Nowak**, supervisor, electronic sales.

Lewis A. Greene, purchasing manager, Aeroquip Corp.'s Jackson Division, Jackson, Mich.

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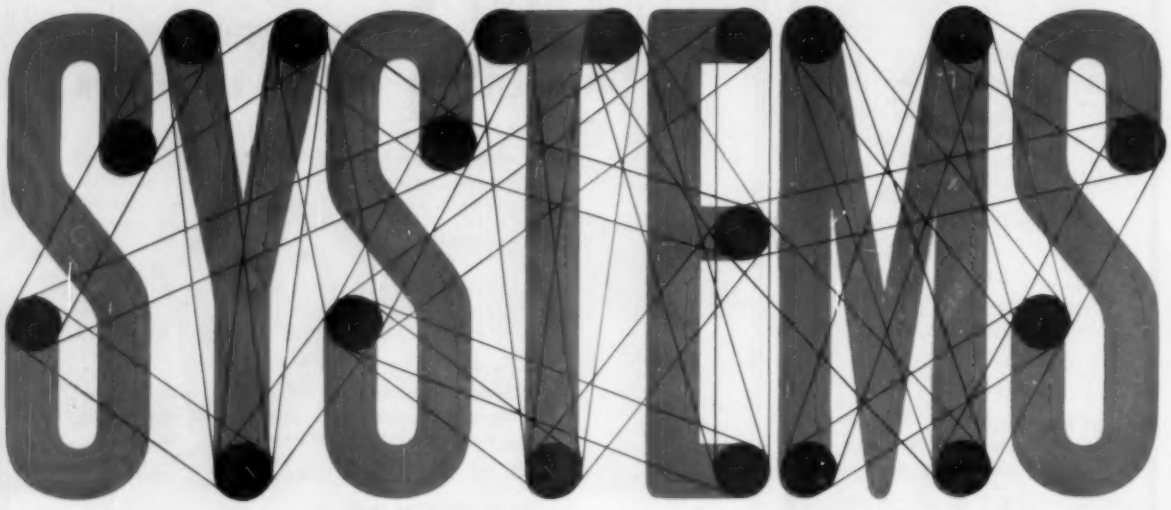

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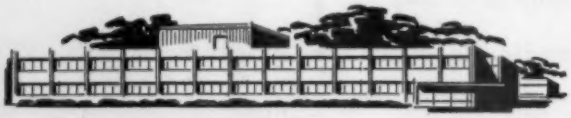

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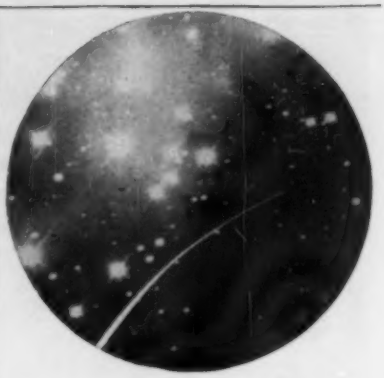

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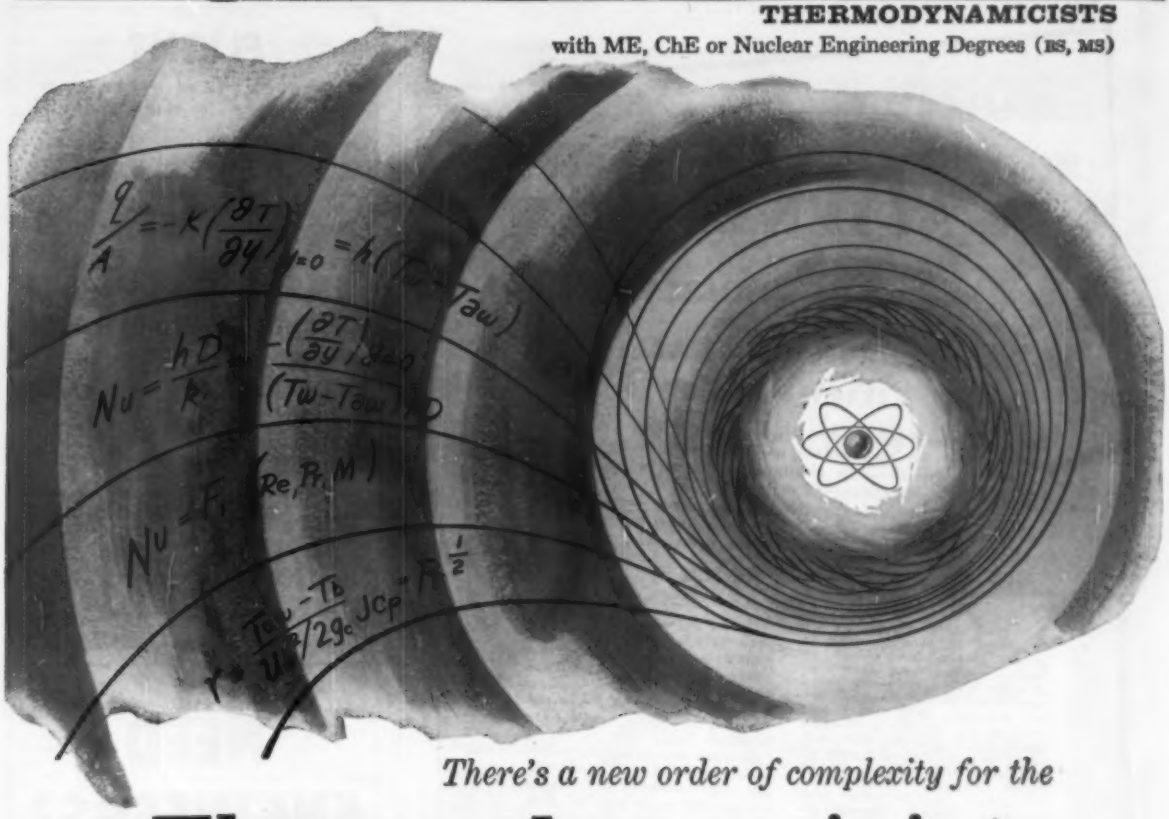
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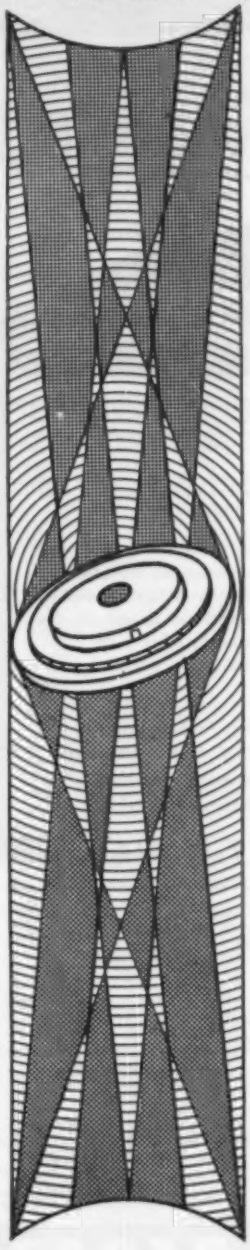

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LETTERS

Weather Reporting

After reading the account of the recent Electra accident and your editorial on "The Cost of False Economy" (AW Feb. 9, p. 21), the point should be stressed in the Electra accident that could be greatly improved with additional funds is the method and accuracy of weather reporting.

Whoever heard of a 400 ft. ceiling, 2 mi. visibility, light rain and fog? You can't have fog and 2 mi. visibility—one or the other, but not both. Everyone talks about poor weather reporting but no one does much about it. More reliance should be given to pilot reports and there should be scheduled "weather hops" to get accurate reports, as could be accomplished by helicopters or light aircraft. It would certainly be nice to get an aerologist to admit the weather is worse than reported and optimistic weather reporting has been responsible for more than one fatal accident, military and civilian alike.

One area which more funds could help vastly would be that of weather reporting from aircraft at distances and altitudes from the field, not by good guesses from a point on the ground, which is one tremendous failing in reporting forward visibilities as so important in the Electra crash and others. Visibility into the sun on a hazy day may be reported as 3 mi. and actually less than ½ mi. to the pilot. Common sense dictates much of the interpretation of weather reports, but every pilot tends to be optimistic or he wouldn't be in the air.

H. B. Davis
Burbank, Calif.

Electra Procedure

One point seems to escape comment in the continued discussion of the LaGuardia Electra disaster. With only an 8 mph. wind, was it really a good idea to divert this flight to the comparatively hazardous back course landing merely to gain a 16 mph. advantage in ground speed over the safer approach?

Charles C. Littell, Jr.
Engineering Associates
Dayton, Ohio

Defense Expenditures

Occasionally your editorial policy seems very one-sided, and one might ask if you are really seeing the broad picture. "The Familiar Mixture," Feb. 2, is an example.

The validity of your arguments could not be denied if the only defensive front we had was military. However, as you know, there is also a serious economic threat, and this, too, appears to have a devastating potential. In order to survive, we must be alert to all threats.

Our defense posture is not improved solely by the expenditure of vast sums. The need is for wise spending. Other things are important, too. For one thing, somebody has to pay the bill—and as of now there seems but scant interest in paying.

Some of the economies you complain about are actually moves to delete widely overlapping or double-up programs. Someone has to act in this direction. If that "someone" happens to be the Administration in Washington, D. C., I say bully for them.

Please do not construe this as dissatisfaction with your fine magazine. I have been for several years, and will continue to be, a faithful subscriber.

Joseph H. Andrews
Chicopee Falls, Mass.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Money-Mad Philosophy

After reading your editorial "Rewards and Responsibility" in the Feb. 16 issue of Aviation Week, I wish to congratulate you on the truly fine and accurate analysis of the typical airline captain.

The airline captain of today lives in a very small world of his own. He surrounds himself by an egotistical, complacent and money-mad philosophy of life. This shell can rarely be penetrated by the people lower than his rank, such as copilots, navigators, flight engineers, flight service, and all the other wonderful hard-working people who make up a successful airline operation.

This might sound rather sharp and severe, but I assure you I have good reason to say this accurately for I am a copilot with one of the largest airlines, serving around the world.

It is truly pitiful that the seniority system, backed up by the Air Line Pilots Assn.'s threats of strike, etc., continually hover over the actions of all the airlines.

The elderly senior captain is forcing himself on the jets for prestige and increased salary. The airlines of today are truly striving for greater service and safety, regardless of what their pilots got salary-wise over the competition airline. This is making ALPA a business medium for outdoing the other airline, which in return brings more money into their money-power-happy association.

I will not go into the system of deliberate over-looking of dangerous techniques and coordination that elderly captains continually show on new equipment checkout, but I will go so far as to say that you and the American air traveler haven't seen anything yet, relative to the recent turboprop and turbojet incidents.

The previous paragraph is a prediction of the terrible and most unfortunate incidents that will follow rapid checkout on new equipment for the elderly captains, for seniority prevails in this industry regardless of aptitude. Besides, in most airlines if the captain with years of flying cannot qualify as a captain on the jet aircraft, etc., they just make him permanent copilot. (This has already been done in the case of PAA jet operation.) So you can see that if the real captain leaves his seat to parade through the cabin, a truly qualified pilot still isn't at the controls in the right seat.

So in closing my letter to you, Mr. Hotz, let me say that the airline industry, pilotwise, had better wise-up to the new and different flying techniques ahead. The "old timer" of 20-30,000 hr. of flying and 50 years old or older hasn't got a single thing in his vast world of "experience" to apply to the speed, altitude, takeoff, climb, and letdown procedures jet aircraft strictly require for safe and efficient operation.

It is the opinion of this writer that ALPA should start paying a darn good staff of public relations people to once again sell and convince the public on ALPA and the airline pilot profession. The recent strikes over pay, crew complement, and flying hours have sure done terrific damage in the attitude of the public towards us all.

An Airline Pilot and ALPA Member
New York, N. Y.

Budget Comments

In the future please send my Aviation Week without the editorial page. Your comments on the federal budget indicate a lack of vision and understanding of the type which has placed our economy in jeopardy. The federal budget has been planned to enable the U.S.A. to win either an economic or shooting war. People who are not foresighted enough to see this deserve public reprimand from us all.

Your recent comments on airline pilots have been asinine. By selecting a few isolated instances, you have cast reflection on the entire group.

Charles E. Bullock
Turkey Hill Road
Ithaca, N. Y.

Alignment Credit

We were very pleased to see the prominent attention you gave to the azimuth alignment theodolites, and their important role in helping to assure the accuracy of long-range missiles (AW Feb. 2, p. 75).

There is one additional point that deserves mention. That is that the particular theodolites we produce for the Jupiter were developed jointly with the Army Ballistic Missile Agency at Redstone Arsenal. The group there, under Dr. Walter Haussermann, Fritz Mueller, and Henry Rothe, was responsible and deserve credit for the over-all alignment system development. Our responsibility was to develop and produce instruments to meet the highly precise requirements of that system.

Unfortunately, there was an oversight in noting this among the several credits when we originally prepared the material and had it cleared through the appropriate agencies.

Carlton W. Miller
General Manager
Electro-Optical Division
The Perkin-Elmer Corp.
Norwalk, Conn.

THE RED KNIGHT OF GERMANY

Brilliantly colored German Fokkers ruled the skies in 1917, flying in tight formations introduced by a young Prussian nobleman whose all-scarlet plane identified him as the Red Baron. He was

(Continued on page 78)

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COMMAND DECISION ON TAKE-OFF

Human engineering principles dictated how take-off information should be presented to the pilot in Servomechanisms' new and advanced take-off monitor. The monitor presents take-off data on servo-driven tapes, freeing the pilot from mental data processing—yet he makes all the command decisions throughout the critical take-off roll.

The ingredients for safety in jet take-offs... or for successful emergency aborting...include the airspeed at which the aircraft takes off, the runway length and runway conditions, as well as computer measurement of the prime variables, distance traveled and indicated airspeed. Since indicated airspeed is measured directly rather than by inference from ground speed, no information as to field altitude, field temperature, wind force or direction is required.

The SMI monitor uses a vertical scale display that shows a plan view of the end of the runway, the continuously predicted actual point of take-off, and the point where the aircraft would stop under maximum braking. The monitor may also be combined with the indicated airspeed display to conserve valuable panel space.

If this newest advancement for air safety is of specific interest, SMI invites your inquiry for detailed information.

Engineers—join SMI in promoting Flight Safety. Positions are available for qualified Engineers and Scientists in the areas of:

Systems Synthesis and Analysis—Project Management—Qualification and Environmental Test Engineering—High Vacuum Deposition Techniques.

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